DOE–EM/GJ641–2004

Hanford Tank Farms Vadose Zone Monitoring Project

Quarterly Summary Report for Second Quarter Fiscal Year 2004

April 2004

U.S. Department of Energy

Work Performed Under DOE Contract No. DE–AC01–02GJ79491 for the U.S. Department of Energy, Grand Junction, Colorado.
Approved for public release; distribution is unlimited.

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Prepared for
U.S. Department of Energy
Office of Environmental Management
Grand Junction, Colorado

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Hanford Tank Farms Vadose Zone Monitoring Project
Quarterly Summary Report for Second Quarter Fiscal Year 2004

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1.0 Introduction

The Hanford Tank Farms Vadose Zone Monitoring Project (VZMP) was established in fiscal year (FY) 2001 for comprehensive routine monitoring of existing boreholes in Hanford single-shell tank farms. The primary goal of routine monitoring is to detect changes in gamma activity that may indicate contaminant migration in the vadose zone. In addition to monitoring 250 priority boreholes that have the highest probability of exhibiting contaminant changes, each borehole in all tank farms is expected to be monitored at least once during a five-year period. The FY 2004 task is a continuation of the monitoring program initiated in FY 2001 and is in accordance with the *Hanford Tank Farms Vadose Zone Monitoring Project, Baseline Monitoring Plan* (DOE 2003). Stoller provides a supervising logging engineer who is responsible to manage the project and coordinate with the CH2M HILL Hanford Group, Inc. (CH2M HILL) operations personnel in day-to-day monitoring activities. Stoller also provides a geophysicist for analysis, interpretation, and reporting of results. Additional special investigative logging may be required that will utilize the Spectral Gamma Logging System (SGLS), the High Rate Logging System (HRLS), and/or the Neutron Moisture Logging System (NMLS). The HRLS is also used to collect data in boreholes where the contaminant activity exceeds the working range of the RAS instrumentation (greater than about 100,000 picocuries per gram [pCi/g] cesium-137 [^{137}Cs]).

The logging system used for monitoring is the Radionuclide Assessment System (RAS). A baseline record of existing contamination associated with gamma-emitting radionuclides in the vadose zone was established between 1995 and 2000 using the SGLS. Although less precise, the RAS is a simpler, faster, and more cost-effective logging system than the SGLS. Measurements collected with the RAS are compared to the baseline data to assess the long-term stability of the radionuclide contaminant profile. When routine monitoring identifies anomalies relative to the baseline, these anomalies may be investigated using the SGLS, HRLS, and the NMLS.

During FY 2003, monitoring in boreholes associated with individual tanks undergoing retrieval operations was added to the work scope detailed in the original VZMP planning documents. Retrieval plans define monitoring requirements including a pre-retrieval baseline measurement, monthly measurements during the retrieval operations, and monthly measurements for six months after retrieval operations cease. Both RAS and NMLS measurements are specified for monthly monitoring, and monthly monitoring is supplemented by manually collected moisture measurements acquired by CH2M HILL personnel over limited depth intervals once or twice per week. During FY 2003, two retrieval projects (tanks C-106 and S-112) were initiated and monitoring has continued into the second quarter of FY 2004. Retrieval in tank C-106 is reported in Hanlon (2003) as having been completed December 31, 2003. Monitoring for retrieval in tank S-102 was initiated at the end of the second quarter. Resources (i.e., RAS) diverted from the routine monitoring to retrieval monitoring have significantly impacted routine monitoring around most of the 149 tanks in the single-shell tank farms.

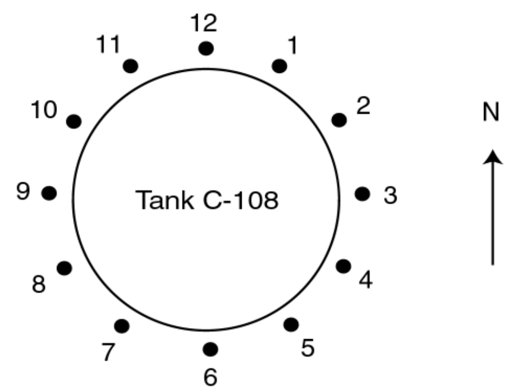
Since FY 2001, routine quarterly reports have been issued to summarize the results of routine monitoring activities, to provide the status of any on-going special investigations, and to provide an updated listing of borehole intervals where monitoring is planned for the next quarter. Retrieval monitoring is an expanded level of effort that requires different strategies for assigning resources, scheduling, and managing. This quarterly report summarizes both routine and retrieval monitoring activities for the second quarter of FY 2004. Because both routine monitoring and retrieval monitoring are performed by the same personnel and equipment, expansion of retrieval monitoring activities tends to impact routine monitoring. These activities are discussed separately below.

For readers not familiar with the Hanford Tank Farms borehole-numbering scheme, the following illustration shows how to identify the location of a borehole from its identification number:

Tank Farm Numbering Scheme

A Farm	10
AX Farm	11
B Farm	20
BX Farm	21
BY Farm	22
C Farm	30
S Farm	40
SX Farm	41
T Farm	50
TX Farm	51
TY Farm	52
U Farm	60

Tank Farm Borehole Numbering Scheme



Boreholes are identified by numbers using the format FF-TT-PP, where "FF" = tank farm, "TT" = tank, and "PP" = the position around the tank in a time-clock numeral from 1 to 12 (12 = north). For example, borehole 30-08-02 is in the C Tank Farm, around tank C-108, and at approximately the 2 o'clock position.

2.0 Routine Monitoring Results

Summaries of monitoring operations from January 1 to March 31, 2004 are included in Tables 2-1 to 2-3.

Table 2-1. Summary of Routine Monitoring Operations for 2nd Quarter of FY 2004

Month	January	February	March	2nd Qtr. Total Projected ( )	FY 04 Total
RAS Routine Monitoring Events	2	2	0	4 (107)	26
Main Log Footage	117	136	0	253	1549
Rerun Log Footage	0	10	0	10	50
Total Footage	117	146	0	263	1599

Table 2-2. Summary of Retrieval Monitoring Operations for 2nd Quarter of FY 2004

Month	January	February	March	2nd Qtr. Total Projected ( )	FY 04 Total
RAS Retrieval Monitoring Events	1	17	2	20 (56)	54
Main Log Footage	122	1778	163	2063	5605
Rerun Log Footage	0	50	0	50	140
Total Footage	122	1828	163	2113	5745

Table 2-3. Summary of NMLS Retrieval Monitoring Operations for 2nd Quarter of FY 2004

Month	January	February	March	2nd Qtr. Total Projected ( )	FY 04 Total
NMLS Retrieval Logging Events	0	17	4	21 (53)	55
Main Log Footage	0	1845	421	2266	5918
Rerun Log Footage	0	170	40	210	540
Total Footage	0	2015	461	2476	6458

Appendix A includes three tables that provide further details of boreholes monitored during the 2nd quarter of FY 2004. Table A-1 presents boreholes/events for routine monitoring with the RAS, and Tables A-2 and A-3 present boreholes/events for RAS and NMLS retrieval monitoring, respectively. Table A-1 is derived from the project's monitoring database, which is continually updated as boreholes are monitored (DOE 2003). Boreholes are selected by a priority score (total score) that emphasizes proximity to tanks with significant drainable liquid remaining and/or the presence of contaminant plumes or where possible contaminant movement is suspected. Where monitoring results suggest possible contaminant movement, the monitoring frequency and monitoring depth intervals may be changed. Consistent with the project requirements of monitoring higher priority boreholes on a relatively frequent basis as well as assuring all boreholes in tank farms are monitored at least once in a five-year period, lower priority boreholes are also selected for monitoring each quarter. On the basis of the FY 2003 rate of monitoring (e.g., approximately 2 boreholes per day), approximately 110 RAS events are expected for routine monitoring each quarter.

Tables A-2 and A-3 present the boreholes monitored for retrieval purposes during the second quarter of FY 2004. The strategy for retrieval monitoring is to log boreholes around a tank before retrieval, once per month during retrieval, and once per month for 6 months after retrieval is complete. Because the RAS does not have moisture logging capability, both the RAS and NMLS are used for each monthly log run. Monitoring frequencies do not change unless anomalous conditions are observed. Each RAS retrieval monitoring event results in approximately one less routine monitoring event. Each NMLS monitoring event requires an additional logging system to be re-deployed from the DOE-RL 200 Areas baseline characterization project and reassignment of the supervising logging engineer from routine monitoring to the retrieval project. One retrieval project was assumed for FY 2004 planning purposes to determine the necessary resources. However, during the second quarter, three retrieval monitoring projects were conducted concurrently and the routine monitoring fell significantly behind planned goals. Measurements were acquired in only four routine monitoring boreholes during the 2nd quarter. It is projected that four retrieval projects will be ongoing in the third quarter. Therefore, given current resources, the routine monitoring project will continue to be adversely impacted.

A total of 24 (4 routine and 20 retrieval) of a scheduled 163 (107 routine and 56 retrieval) monitoring events were performed during the second quarter of FY 2004. The following sections describe the routine monitoring performed in each tank farm. Table 2-4 lists all the boreholes that have indicated potential changes in radionuclide contaminant profile since the inception of the monitoring project in June 2001. Plots for the respective boreholes are included in the referenced quarterly or fiscal year reports. Of the 29 boreholes showing increases, only borehole 30-08-02 was monitored during the 2nd quarter. This borehole is near tank C-106, where retrieval activities were recently completed.

Table 2-4. Summary of Monitored Boreholes Indicating Radionuclide Contaminant Profile Changes

Tank Farm	Borehole Number	Radio-nuclide	Deter-mined	Number of Events	Assessment	Assigned Frequency	Qtrly/Annual Report
BX	21-12-02	^{60}Co	9/23/03	3	Possible decrease	6 mos.	FY 2003
BX	21-27-08	^{238}U/^{235}U	03/13/02	5	Not confirmed	6 mos.	2nd 2002
BY	22-03-04	^{60}Co	11/15/01	3	Not confirmed	6 mos.	1st 2002
BY	22-07-02	^{60}Co	11/29/01	3	Not confirmed	6 mos.	1st 2002
BY	22-07-05	^{60}Co	12/12/01	3	Not confirmed	6 mos.	1st 2002
BY	22-08-05	^{60}Co	03/30/99	4	Not confirmed	6 mos.	1st 2002
C	30-06-10	^{60}Co	03/03/97	8	Definite increase	1 mos.	3rd 2002
C	30-08-02	^{60}Co	09/11/02	8	Definite increase	1 mos.	FY 2002
C	30-08-03	?	1/21/03	2	Not confirmed	3 mos.	FY 2003
S	40-02-03	^{137}Cs	7/9/03	1	Definite increase	1 mos.	FY 2003
SX	41-02-02	^{137}Cs/^{90}Sr	09/07/01	5	Not confirmed	6 mos.	FY 2001
SX	41-10-01	^{137}Cs	2/11/03	4	Definite increase	6 mos.	FY 2003
SX	41-15-07	^{137}Cs	2/12/03	2	Not confirmed	6 mos.	FY 2003
T	50-01-09	^{60}Co	07/30/01	5	Not confirmed	6 mos.	FY 2001
T	50-02-05	^{137}Cs	5/19/03	4	Not confirmed	6 mos.	FY 2003
T	50-06-02	^{60}Co/^{154}Eu	07/18/01	5	Not confirmed	6 mos.	FY 2001
T	50-06-03	^{60}Co	07/18/01	5	Not confirmed	6 mos.	FY 2001
T	50-06-18	^{60}Co	09/03/02	5	Possible increase	3 mos.	FY 2002
T	50-04-10	^{60}Co	01/28/02	5	Poss. confirmation	3 mos.	2nd 2002
T	50-09-01	^{60}Co/^{154}Eu	07/23/01	5	Not confirmed	6 mos.	FY 2001
T	50-09-02	^{60}Co	01/08/02	3	Not confirmed	12 mos.	2nd 2002
T	50-09-10	^{60}Co/^{154}Eu	07/23/01	5	Not confirmed	6 mos.	FY 2001
TX	51-03-11	^{60}Co	05/20/02	2	Possible increase	6 mos.	3rd 2002
TY	52-03-06	^{137}Cs	05/02/02	5	Definite change	3 mos.	3rd 2002
TY	52-06-05	^{60}Co	05/14/02	3	Possible increase	3 mos.	3rd 2002
TY	52-06-07	^{60}Co	5/22/03	2	Not confirmed	12 mos.	FY 2003
U	60-04-08	^{238}U/^{235}U	07/16/01	8	Not confirmed	6 mos.	FY 2001
U	60-05-05	^{238}U/^{235}U	08/27/02	5	Possible increase	6 mos.	FY 2002
U	60-07-01	^{238}U/^{235}U	07/12/01	8	Not confirmed	6 mos.	FY 2001

2.1 A Tank Farm

Routine monitoring was not performed in A Farm during the 2nd quarter of FY 2004.

2.2 AX Tank Farm

Routine monitoring was not performed in AX Farm during the 2nd quarter of FY 2004.

2.3 B Tank Farm

Routine monitoring was not performed in B Farm during the 2nd quarter of FY 2004.

2.4 BX Tank Farm

Routine monitoring was not performed in BX Farm during the 2nd quarter of FY 2004.

2.5 BY Tank Farm

Routine monitoring was not performed in BY Farm during the 2nd quarter of FY 2004.

2.6 C Tank Farm

A total of 15 boreholes located around tanks C-104, -105, -106, -108, and -109 were monitored during the 2nd quarter of FY 2004. Eleven of these boreholes associated with tank C-106 were monitored once in support of the C-106 Waste Retrieval Project. With the exception of borehole 30-00-01, these boreholes were also logged once with the NMLS. This work is discussed in detail in Section 3.1, "Tank C-106 Retrieval Monitoring."

Four routine monitoring boreholes were logged. No contaminant movement was observed when measurements were compared to the baseline.

2.7 S Tank Farm

A total of 11 boreholes located around tanks S-102, -109, -111, and -112 were monitored during the 2nd quarter of FY 2004. All of these boreholes were monitored in support of the S-102 and S-112 Waste Retrieval Projects. These boreholes were also logged with the NMLS. This work is discussed in detail in Sections 3.2 and 3.3, "Tank S-112 Retrieval Monitoring" and "Tank S-102 Retrieval Monitoring," respectively.

Routine monitoring was not performed in S Farm during the 2nd quarter of FY 2004.

2.8 SX Tank Farm

Routine monitoring was not performed in SX Farm during the 2nd quarter of FY 2004.

2.9 T Tank Farm

Routine monitoring was not performed in T Farm during the 2nd quarter of FY 2004.

2.10 TX Tank Farm

Routine monitoring was not performed in TX Farm during the 2nd quarter of FY 2004.

2.11 TY Tank Farm

Routine monitoring was not performed in TY Farm during the 2nd quarter of FY 2004.

2.12 U Tank Farm

Routine monitoring was not performed in U Farm during the 2nd quarter of FY 2004.

3.0 Retrieval Monitoring

3.1 Tank C-106 Retrieval Monitoring

Retrieval activities in tank C-106 were completed December 31, 2003 (Hanlon 2003). Additional RAS post-retrieval monitoring and NMLS moisture logging measurements were acquired in boreholes surrounding the tank in the 2nd quarter of FY 2004. During the 1st quarter of FY 2003, observations of increasing moisture content in the vicinity of tank C-106 resulted in the initiation of a "Problem Evaluation Request" (PER) on December 3, 2003. In response to the PER, SGLS measurements were acquired in six boreholes during the 2nd quarter to determine if the moisture increases were accompanied by increases in gamma activity that might reflect leakage from the tank. Appendix B includes an interim report of drywell monitoring data collected in support of the retrieval project through March 2004.

This interim report concluded:

- On the basis of gamma measurements that indicated no increase in activity, moisture increases are likely related to seasonal fluctuations rather than from a tank leak.
- Tank C-108 should be investigated for possible leakage as the source of a dynamic vadose zone plume that is migrating eastwardly underneath tank C-106.
- Moisture measurements must be supplemented with gamma measurements for leak detection.

Additional measurements will be acquired in these boreholes during June 2004 that will conclude retrieval monitoring. It is expected the boreholes will revert to routine monitoring at that time.

3.2 Tank S-112 Retrieval Monitoring

RAS retrieval monitoring and NMLS moisture logging continued in eight boreholes through the 2nd quarter of FY 2004. Possible moisture increases observed between 25 and 50 ft in some boreholes during the 1st quarter were not confirmed by subsequent measurements in the 2nd quarter. No significant increases in gamma activity were observed during this time. Monthly measurements are projected to continue up to six months after retrieval activities have ceased. An interim report of monitoring results will be issued when retrieval is complete.

3.3 Tank S-102 Retrieval Monitoring

Pre-retrieval monitoring was initiated at the end of the quarter. Moisture logging was completed in three boreholes and SGLS logging was completed in one borehole. Results of this logging are being provided to CH2M HILL. These data will be used to provide a baseline for the retrieval and to provide information to support the high-resolution resistivity (HRR) leak detection mitigation and monitoring (LDMM) system that will be tested during this retrieval. All boreholes surrounding this tank have been assigned a monthly monitoring frequency with the RAS and NMLS during the remainder of FY 2004.

3.4 Tank C-103 Retrieval Monitoring

Pre-retrieval monitoring with the RAS and NMLS are scheduled to begin during the 3rd quarter of FY 2004.

3.5 Tank C-105 Retrieval Monitoring

Borehole 30-05-07 was logged with the HRLS during the 2nd quarter of FY 2004 to re-baseline a zone of high gamma flux. No change in concentrations was observed. Pre-retrieval monitoring with the RAS and NMLS are scheduled to begin during the 3rd quarter of FY 2004.

4.0 Special Investigations

4.1 Tank C-105 Characterization

A characterization borehole was drilled and logged during March 2004. Logging results are included in Appendix C.

5.0 Operational Issues

During the second quarter of FY 2004, an average of approximately 0.4 boreholes were monitored per working day. This rate incorporates all operational aspects of monitoring, including both scheduled and unscheduled down time for maintenance, operator support, security, etc.

The routine and retrieval monitoring projects experienced 42.1 days of down time during the second quarter of FY 2004. The majority of this down time was due to four major factors: 1) lack of dedicated operator support, 2) extreme weather, 3) a broken crystal in the large detector, and 4) the annual calibration.

The RAS project has lower priority than other tank farms projects, and RAS operators are frequently diverted to other tasks. When operators are available, they are generally assigned to support the RAS retrieval effort or the CH2M HILL handheld moisture measurements. Thus, the RAS routine monitoring is often not supported. With the current workload, the RAS is assigned approximately 100% of the time in support of retrieval projects.

Table 5-1 summarizes monthly logging production, and Table 5-2 identifies operational issues that affect monitoring production.

Table 5-1. Summary of Monitoring Production (Project-to-Date)

Quarter	Total Work Days	Total Days Down	Total Monitoring Events	Boreholes Monitored per Day
4th of FY01	56	29.3	84	1.5
1st of FY02	56	35.2	54	1.0
2nd of FY02	55	34.1	74	1.3
3rd of FY02	59	21.1	113	1.9
4th of FY02	66	27.6	144	2.2
1st of FY03	56	34.7	72	1.3
2nd of FY03	55	22.5	97	1.8
3rd of FY03	58	25.0	105	1.8
4th of FY03	63	22.6	103	1.6
1st of FY04	56	27.4	56	1.0
2nd of FY04 (current)	55	42.1	24	0.4
Cumulative Total	635	321.6	926	1.5
Average/Quarter	57.7	29.2	84.2	1.5

Table 5-2. Summary of Operational Down Time (Project-to-Date)

Quarter	Equipment/ Truck Problems/Calibration (hrs)	No HPT/ Operator Support (hrs)	Security Measures (hrs)	No Charge Code or Administrative (hrs)	Moving Truck (hrs)	Weather (hrs)	Misc. (hrs)	Total Down Time (hrs)
4th of FY01	64	130	20	27	20	3	0	264
1st of FY02	107	84	51	44	14	13	4	317
2nd of FY02	143	40	24	58	9	18	15	307
3rd of FY02	31	62	0	36	27	8	26	190
4th of FY02	81	122	0	0	37	0	8	248
1st of FY03	71	107	0	18	18	0	98	312
2nd of FY03	62	126	0	0	10	0	0	198
3rd of FY03	51	149	0	0	12	0	13	225
4th of FY03	45	136	0	0	16	6	0	203
1st of FY03	6	198	0	0	12	22	9	247
2nd of FY04 (current)	178	95	0	0	6	98	2	379
Cumulative Total	839	1249	95	183	181	169	175	2891
Average/Quarter	76.3	113.5	8.6	16.6	16.5	15.4	15.9	262.8

6.0 Future Monitoring Operations

Appendix D provides a summary by tank farm of boreholes scheduled for monitoring through the end of the 3rd quarter of FY 2004. On the basis of two boreholes per day, Table D-1 includes 113 routine monitoring boreholes that could be logged with sufficient operator support and equipment (one RAS). Appendix Tables D-2 and D-3 include boreholes associated with the five ongoing and planned waste retrieval projects. With the exception of tank C-106 boreholes, these boreholes are scheduled to be monitored on a monthly basis. Tank C-106 boreholes are scheduled for one event in June. Tank C-103 and -105 boreholes are projected to be monitored two times each this quarter, and tank S-102 and -112 boreholes are projected to be monitored three times each. Approximately 92 monitoring events with the RAS are projected to be conducted for retrieval during the third quarter of FY 2004; approximately 88 NMLS monitoring events are also projected to occur concurrent with the RAS retrieval events. Because the retrieval monitoring takes precedence over the routine monitoring, the maximum number of routine monitoring events that could be performed in the 3rd quarter would be 21 (113 routine - 92 retrieval), which is less than 20 percent of the desired number necessary to maintain a credible monitoring program. Given the past performance, it is unlikely any routine monitoring will be performed in the coming quarter.

7.0 Issues

The following deficiencies are expected during the 3rd quarter of FY 2004:

- Little or no routine monitoring will be performed.
- Twenty-nine boreholes that have exhibited change in the past will not be monitored.
- Twenty-four boreholes with the highest gamma activity, inventory of contaminants, and highest potential for change require high rate logging. These boreholes have not been monitored since Spring 2002, and are not currently scheduled for logging this quarter.
- Retrieval support monitoring requirements may not be completely met.

A credible routine monitoring program is an important tool in demonstrating the long-term stability of subsurface contaminant plumes, to identify areas in which contaminant migration is occurring, and leak detection. This information is important for input into contaminant transport models that will be used for risk assessment. Monitoring data also provide a basis by which the long-term stability of vadose zone contaminant plumes can be demonstrated. This allows consideration of no further action and/or monitored natural attenuation as a credible remedial alternative.

Furthermore, monitoring of existing drywells before, during, and after retrieval operations is an important component of the overall leak detection process. The current monitoring (routine and retrieval) projects are based on the deployment of a single RAS. It is recommended that additional monitoring systems be provided as the scope of the waste retrieval program increases and to preclude routine monitoring from not being accomplished as planned. A commercially available logging system capable of concurrent gamma activity and neutron moisture measurements has been identified, but no funding has been provided for procurement and deployment.

References

Hanlon, B.M., 2003. *Waste Tank Summary Report for Month Ending December 31, 2003*, HNF-EP-0182, Rev. 189, CH2M HILL Hanford Group, Inc., Richland, Washington.

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U.S. Department of Energy (DOE), 2003. *Hanford Tank Farms Vadose Zone Monitoring Project, Baseline Monitoring Plan*, GJO-HGLP 1.8.1, Revision 0, Grand Junction Office, Grand Junction, Colorado.

Appendix A
Boreholes Monitored During the 2nd Quarter of FY 2004

Table A-1. Routine Boreholes Monitored During the 2nd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Rerun Footage	Log Freq. (days)	Next Log Date	Last Event	Total 2nd Qrt. Events	Total Events (to date)	Comment
30-04-04	C-104	30	98	68	10	1800	01/07/09	02/03/04	1	1	No apparent change
30-04-05	C-104	30	98	68		1800	01/07/09	02/03/04	1	1	No apparent change
30-05-06	C-105	0	57	57		1800	01/01/09	01/28/04	1	1	No apparent change
30-05-09	C-105	30	90	60		1800	12/30/08	01/26/04	1	1	No apparent change
			Total Routine Monitoring Events This Quarter =						**4**		

Table A-2. Retrieval Boreholes Monitored During the 2nd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Rerun Footage	Next Log Date	RAS Event A	RAS Event B	RAS Event C	RAS Event D	RAS Event E	RAS Event F	Ras Event G	Ras Event H	Total 2nd Qrt. Events	Total Events (to date)	Comment
30-00-01	C-106	0	65	65		04/06/04	04/24/02	01/16/03	04/28/03	07/22/03	09/15/03	11/03/03	12/02/03	03/01/04	1	8	No apparent change, C-106 Retrieval
30-05-02	C-105	5	127	122	10	03/26/04	04/22/02	01/29/03	04/29/03	07/23/03	09/17/03	10/23/03	12/15/03	02/19/04	1	8	No apparent change, C-106 Retrieval
30-06-02	C-106	0	122	122		03/30/04	01/27/03	04/28/03	07/21/03	09/16/03	10/21/03	01/26/04	02/23/04		2	7	No apparent change, C-106 Retrieval
30-06-03	C-106	0	98	98		03/30/04	01/23/03	04/28/03	07/21/03	09/16/03	10/22/03	12/02/03	02/23/04		1	7	No apparent change, C-106 Retrieval
30-06-04	C-106	0	129	129		04/01/04	09/11/02	01/27/03	04/29/03	07/23/03	09/17/03	10/31/03	12/22/03	02/25/04	1	8	No apparent change, C-106 Retrieval
30-06-09	C-106	5	98	93	10	03/26/04	04/22/02	01/22/03	04/22/03	07/22/03	09/10/03	10/23/03	12/12/03	02/19/04	1	8	No apparent change, C-106 Retrieval
30-06-10	C-106	0	128	128		04/02/04	04/23/02	01/23/03	04/22/03	07/22/03	09/08/03	11/03/03	12/22/03	02/26/04	1	8	Possible change 124-126 ft Co-60, C-106 Retrieval
30-06-12	C-106	0	98	98		04/06/04	04/24/02	01/24/03	04/29/03	07/22/03	09/11/03	10/22/03	12/08/03	03/01/04	1	8	No apparent change, C-106 Retrieval
30-08-02	C-108	30	99	69		03/17/04	09/11/02	09/12/02	01/21/03	05/05/03	07/30/03	11/04/03	12/17/03	02/17/04	1	8	Def. change Co-60 49-75 ft, down, C-106 Retrieval
30-09-06	C-109	30	98	68	10	03/20/04	04/23/02	01/29/03	05/05/03	07/30/03	10/31/03	12/12/03	02/20/04		1	7	No apparent change, C-106 Retrieval
30-09-07	C-109	30	121	91		03/17/04	09/11/02	01/16/03	05/02/03	07/30/03	10/29/03	12/15/03	02/17/04		1	7	No apparent change, C-106 Retrieval
40-09-06	S-109	0	98	98		03/12/04	06/05/02	03/11/03	08/27/03	10/15/03	11/24/03	02/05/04			1	6	No apparent change; S-112 Retrieval
40-11-08	S-111	0	97	97	10	03/11/04	06/03/02	10/17/03	11/25/03	02/04/04					1	4	No apparent change, S-112 Retrieval
40-11-09	S-111	0	98	98		03/12/04	06/05/02	06/18/03	10/16/03	12/01/03	02/05/04				1	5	No apparent change, S-112 Retrieval
40-12-02	S-112	0	99	99		03/12/04	06/05/02	03/12/03	08/27/03	10/16/03	11/24/03	02/05/04			1	6	No apparent change; S-112 Retrieval
40-12-04	S-112	0	126	126		03/11/04	06/04/02	03/10/03	08/22/03	10/09/03	11/25/03	02/04/04			1	6	No apparent change; S-112 Retrieval
40-12-06	S-112	0	144	144	10	03/16/04	06/04/02	03/10/03	08/21/03	10/14/03	11/19/03	02/09/04			1	6	No apparent change; S-112 Retrieval
40-12-07	S-112	0	98	98		03/13/04	06/04/02	03/11/03	08/26/03	10/08/03	11/19/03	02/06/04			1	6	No apparent change; S-112 Retrieval
40-12-09	S-112	0	98	98		03/13/04	06/05/02	03/11/03	08/27/03	10/14/03	11/17/03	02/06/04			1	6	No apparent change; S-112 Retrieval
										Total Retrieval Monitoring Events This Quarter =					**20**		

Table A-3. Retrieval Boreholes Logged with the Neutron/Moisture Logging System During the 2nd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Rerun Footage	Next Event	NMLS Event 1	NMLS Event 2	NMLS Event 3	NMLS Event 4	NMLS Event 5	NMLS Event 6	Total 1st Qrt. Events	Total Events (to date)	Comment
30-05-02	C-105	0	127	127	10	03/12/04	04/28/03	07/21/03	09/08/03	10/22/03	12/02/03	02/11/04	1	6	Possible increase 42-70 ft
30-06-02	C-106	0	122	122	10	03/19/04	04/30/03	07/22/03	09/10/03	10/20/03	12/04/03	02/18/04	1	6	Possible increase 56-76 ft
30-06-03	C-106	0	98	98	10	03/18/04	04/30/03	07/22/03	09/09/03	10/21/03	12/04/03	02/17/04	1	6	Possible increase 57-68 ft
30-06-04	C-106	0	129	129	10	03/31/04	04/30/03	07/23/03	09/11/03	10/23/03	12/10/03	03/01/04	1	6	Possible increase 45-53 ft
30-06-09	C-106	0	98	98	10	03/13/04	04/28/03	07/21/03	09/08/03	10/22/03	12/02/03	02/12/04	1	6	Possible increase 50-72 ft
30-06-10	C-106	0	128	128	10	03/18/04	04/29/03	07/22/03	09/04/03	10/21/03	12/03/03	02/17/04	1	6	Possible increase 42-58 ft
30-06-12	C-106	0	98	98	10	03/19/04	04/29/03	07/22/03	09/09/03	10/21/03	12/04/03	02/18/04	1	6	Possible increase 50-60 ft
30-08-02	C-108	0	99	99	10	03/21/04	12/09/03	02/20/04					1	2	No apparent change
30-09-06	C-109	0	98	98	10	03/13/04	12/08/03	02/12/04					1	2	No apparent change
30-09-07	C-109	0	121	121	10	03/13/04	12/08/03	02/12/04					1	2	No apparent change
40-09-06	S-109	0	98	98	10	03/10/04	08/27/03	10/09/03	11/25/03	02/09/04			1	4	Possible increase 40-50 ft
40-11-08	S-111	0	96	96	10	03/10/04	10/14/03	11/26/03	02/09/04				1	3	None
40-11-09	S-111	0	98	98	10	03/07/04	10/14/03	11/25/03	02/06/04				1	3	Possible increase 23-33 ft
40-12-02	S-112	0	99	99	10	03/07/04	08/26/03	10/08/03	11/25/03	02/06/04			1	4	Possible increase 32-47 ft
40-12-04	S-112	0	126	126	10	03/10/04	08/27/03	10/14/03	11/26/03	02/09/04			1	4	Possible increase 53-55 ft
40-12-06	S-112	0	144	144	10	03/11/04	08/26/03	10/09/03	11/24/03	02/10/04			1	4	Possible increase 35-49 ft
40-12-07	S-112	0	96	96	10	03/11/04	08/25/03	10/08/03	11/24/03	02/10/04			1	4	Possible increase 23-43 ft
40-12-09	S-112	0	99	99	10	03/10/04	08/26/03	10/08/03	11/24/03	02/09/04			1	4	Possible increase 37-50 ft
40-02-05	S-102	0	97	97	10	04/24/04	03/25/04						1	1	Only one event, no comparison
40-02-11	S-102	0	100	100	10	04/24/04	03/25/04						1	1	Only one event, no comparison
40-02-07	S-102	0	95	95	10	04/30/04	03/31/04						1	1	Only one event, no comparison
							Total Retrieval Moisture Logging Events This Quarter =						**21**		

Appendix B
241-C-106 Tank Waste Retrieval Project Interim Report of Drywell Monitoring Data

Stoller
Hanford Office

March 22, 2004

241-C-106 Tank Waste Retrieval Project
Interim Report of Drywell Monitoring Data

Introduction

241-C-106 is an underground radioactive waste storage tank located in the 241-C Tank Farm in the 200 East Area of the Hanford Site. This tank is a 75-foot (ft)-diameter underground domed concrete structure, with a carbon steel liner on the sides and bottom. The base of the tank is approximately 38 ft below ground surface, and approximately 9 ft of backfill covers the dome. Nominal capacity of the tank is 533,000 gallons. Waste retrieval operations for this tank were successfully concluded in December 2003 with the removal of all but a nominal amount of tank waste.

Waste retrieval operations required limited additions of water and oxalic acid to mobilize the waste for removal. In the Process Control Plan (May and Reynolds 2003), the baseline leak-detection method is gamma and neutron moisture logging in drywells surrounding C-106 on a six-week schedule supplemented by moisture monitoring with hand-held instruments twice per week. Routine gamma monitoring in drywells with the radionuclide assessment system (RAS) is performed by CH2M HILL Group, Inc., (CH2M HILL) personnel with technical oversight by the S.M. Stoller Corporation (Stoller). Logging with the neutron moisture logging system (NMLS) and high-resolution spectral gamma logging system (SGLS) is performed by Stoller personnel. The hand-held moisture measurements are under the purview of CH2M HILL and will only be discussed here in the context of the log data.

Observations of increasing moisture content in the vicinity of C-106 resulted in the initiation of a "Problem Evaluation Request" (PER) on December 3, 2003. The PER specifically stated *"Increased moisture content (~1%) in the vadose zone beneath Tank 241-C-106 may be indicative of a loss of tank integrity. Moisture monitoring is done because, few if any mobile gamma emitting radionuclides remain in the tank.*"

The purpose of this letter report is to summarize available drywell data collected to date and address the concerns raised in the PER.

Available Geophysical Log Data

Gross gamma logs were routinely collected in C Farm drywells until 1994. These data are available in electronic format from 1975 to 1994 and have been evaluated by Randall and Price (2001).

Other studies conducted on tank C-106 in the past include discussion of subsurface conditions and geophysical log data. These studies include Washington State Department of Ecology (1992), Brodeur (1993), and Barnes (2000). These reports pre-date the current retrieval effort and are not discussed further in this report because they provide no information regarding the impact of recent retrieval operations.

A baseline of subsurface contamination conditions in the vicinity of tank C-106 was established in 1997 and reported in the *Tank Summary Data Report for C-106* (DOE 1997). A discussion of subsurface contamination conditions and visualization of subsurface contaminant plumes was published in the *C Tank Farm Report* (DOE 1998) and updated in 2000 (DOE 2000).

In response to the PER, moisture data were acquired in borehole 30-05-02 on December 8, 2003, five days after the PER was issued and six days after the previous moisture measurement. Additional boreholes (30-08-02, 30-09-07, and 30-09-06) were selected for moisture measurements to help assess changes in subsurface moisture away from the tank.

SGLS data were not acquired until February 2004 due to inclement weather and system availability. RAS measurements were acquired during December 2003. No apparent increases in gamma activity were observed. SGLS measurements were collected in late February and early March in boreholes 30-06-02, -04, -09, -10, 30-05-02, and 30-08-02.

Table 1 below summarizes the number of logging events with each logging system for each borehole that can provide relevant information to the tank C-106 retrieval operations. Figure 1 shows the locations of these boreholes relative to tank C-106. Logging depth intervals where apparent changes in gamma activity and/or moisture have been observed are indicated.

Table 1. Summary of Logging Measurements Acquired for Evaluation of the C-106 Retrieval Operations

Borehole	SGLS	RAS	NMLS	Gamma Change	Moisture Change
30-06-02	2	7	6	None	56-72 ft
30-06-03	1	7	6	None	55-67 ft
30-06-04	2	8	6	85-91 ft	46-55 ft
30-05-02	2	8	7	None	41-62 ft
30-06-09	2	8	6	None	50-72 ft
30-06-10	3	7	6	116-130 ft	42-54 ft
30-06-12	1	7	6	None	50-60 ft
30-08-02	2	7	2	47-80 ft	None
30-09-07	1	7	2	None	None
30-09-06	1	7	2	78-87 ft	None

Figures 2a through 11a present a graphical summary of these data collected in support of the C-106 retrieval to March 2004; retrieval operations ceased December 31 (Hanlon 2003). These data include the man-made radionuclides (^{137}Cs and ^{60}Co), ^{40}K, ^{232}Th concentrations, and total gamma collected with the SGLS and RAS, and NMLS measurements.

Figures 2b through 11b show the NMLS data with depth intervals expanded so that subtle changes in moisture can be viewed. A limited number of handheld moisture measurements are also included that span the time period from July to October 2003.

Figure 12 shows a cross section (A-A') from borehole 30-08-02 west of tank C-106 to borehole 30-00-01 east of the tank. The cross section indicates a slight east-northeast stratigraphic dip in the vicinity of tank C-106.

Preliminary Observations and Findings

When all available data are compiled, pre-retrieval vadose zone conditions in the immediate vicinity of tank C-106 appear to not have significantly changed for either moisture or gamma activity up to March 2004, except for borehole 30-06-10, where gamma activity shows downward and lateral movement below 86-ft depth. This contaminant movement was recognized in the tank summary data report (DOE 1997). It was confirmed by SGLS logging and reported to DOE in March 1999 (Bertsch 1999).

Slight moisture increases are shown in all boreholes, with the largest increases (approximately 1 percent) indicated in boreholes 30-05-02 and 30-06-09 located southwest of tank C-106. These moisture increases appear to have occurred between July and September 2003, although this is not conclusive. The changes appear to have stabilized since December 2003, although additional measurements should be acquired to confirm this observation.

Generally, the top 10 ft of the boreholes show decreasing moisture content in the sediments between April and December 2003 with increases between December 2003 and March 2004. The decrease is likely due to evapotranspiration during the warmer months, and the increase is likely the result of infiltration from rain and snowmelt. No changes are apparent between the upper 10.0 ft and the depths below the tanks where moisture changes have been observed. Figure 4c compares the current moisture profile to moisture measurements acquired in 1976 in borehole 30-06-04. The moisture profiles are very similar, suggesting relatively static conditions in the vadose zone over almost 30 years.

The seven or eight RAS measurements collected in boreholes around tank C-106 do not indicate any increase in gamma activity within the intervals of moisture increases or high moisture zones in the vicinity of tank C-106. The numerous thin zones of relatively high moisture appear to be "perched" above fine-grained sediment layers, some of which can be correlated across the area of the cross section. For example, the excavation surface at an elevation of approximately 612 ft (log depth 38 ft) appears to be associated with relatively thin intervals of higher moisture content (Figure 12). Another significant layer is observed at an elevation of 570 ft (log depth 80 ft). This layer appears to influence lateral movement of contamination, but it may not be continuous across the tank farm.

SGLS measurements were collected in boreholes 30-06-02, -04, -09, -10, 30-05-02, and 30-08-02. These data were compared to SGLS data collected in 1997. As with the RAS measurements, no significant changes are observed in depth intervals where slightly elevated moisture was detected. Changes were observed in boreholes 30-08-02 and 30-06-10. In borehole 30-08-02 (Figures 9 and 12), ^{60}Co contamination continued to increase between elevations of 602 and 576 ft (log depths 47 to 73 ft). In borehole 30-06-10, ^{60}Co contamination is encountered at elevation 564 (86-ft log depth). After accounting for decay, ^{60}Co concentrations appear to be relatively stable between 86-ft and 112-ft depth, but the lower extent of the ^{60}Co plume has moved downward from 116-ft depth in 1997 to the bottom of the borehole at 129 ft by 2004. Figure 12 shows the relationships between the boreholes. The ^{60}Co contamination appears to originate from the vicinity of tank C-108 and follows stratigraphic dip to the east-northeast, and probably extends past borehole 30-06-12 at depths greater than 130 ft. This contamination was recognized well before retrieval operations began, and does not appear to have been impacted by retrieval activities in tank C-106. However, the existence of this plume and its continued movement downward and to the east do call into question the integrity of tank C-108.

Conclusions

The premise stated in the PER for moisture logging in support of the tank C-106 retrieval is that "few if any mobile gamma emitting radionuclides remain in the tank." However, when moisture increases were observed, requests for gamma logging were made to confirm or deny the existence of a tank leak. If the assumption is made that there are in fact no mobile gamma-emitting radionuclides present in the waste material, then the observed zones of moisture increase could be an indication of a tank leak associated with retrieval operations. However, Stoller's experience with tank farm logging suggests that even though radionuclides such as ^{137}Cs and ^{60}Co are not considered highly mobile, detectable gamma activity would be associated with any tank waste in the vadose zone. No long-term baseline has been established for neutron moisture data, and the observed increases in moisture content may simply be related to seasonal fluctuations. In Stoller's opinion, the lack of observable increases in gamma activity associated with the moisture increases strongly suggests that the moisture increases are related to seasonal fluctuations, but available data are not sufficient to conclusively prove that no tank leak occurred.

Subsurface contamination may not necessarily be associated with high moisture content. For example, the ^{60}Co contamination movement in boreholes 30-08-02 and 30-06-10 (Figure 12) does not appear to be associated with moisture anomalies. It appears that if moisture is driving contaminant movement, the magnitude of the changes may be very small (e.g., approximately 1% volumetric fraction) such as observed around tank C-106. The ^{60}Co contamination in borehole 30-08-02 occurs in the same general depth range as moisture increases around tank C-106. Therefore, perhaps slight moisture increases resulting from natural seasonal fluctuations are sufficient to provide a mechanism to drive contamination through the vadose zone.

Experience with leak-detection monitoring around tank C-106 strongly suggests that moisture measurements alone are not sufficient. Gamma activity measurements in the existing boreholes remain an important component of leak-detection monitoring, because a significant increase in gamma activity provides unequivocal evidence of a leak.

Currently, gamma measurements with the RAS that can be compared with the SGLS baseline have been acquired in all but a few boreholes in C Farm. Results of these measurements indicate that only three boreholes (30-08-02, -03, and 30-06-10) have shown contaminant movement since 1997. These boreholes are all in the same general vicinity.

Recommendations

Continued reliance on neutron moisture measurements as the primary means of leak detection is not recommended; no long-term baseline of neutron moisture measurements has been established, and it is impossible to determine if small increases are related to waste retrieval operations or simply to normal seasonal fluctuations. Logging systems capable of concurrent measurement of both gamma activity and moisture content are available and should be incorporated into leak detection, monitoring, and mitigation (LDMM) requirements for tank retrieval operations as soon as possible. Other geophysical methods, such as high-resolution resistivity (HRR) also may play an important role in leak detection. However, methods such as HRR also respond primarily to changes in moisture content, which are not necessarily related to tank leaks. Therefore, it is likely that any anomalies detected by HRR will require investigation by gamma logging.

The elevated moisture measured around tank C-106 should be investigated further. If the premise that the tank contains no mobile gamma-emitting radionuclides is accurate, the SGLS and RAS measurements do not conclusively rule out a potential tank leak during retrieval operations. ^{99}Tc or other mobile radionuclides not detectable by gamma logging could be associated with the moisture increases.

Tank C-108 should be investigated for possible leakage as the source of the plume observed in borehole 30-08-02 and 30-06-10. This ^{60}Co plume should be investigated for co-contaminants such as ^{99}Tc, as well as, to determine contaminant transport characteristics that result in this dynamic situation.

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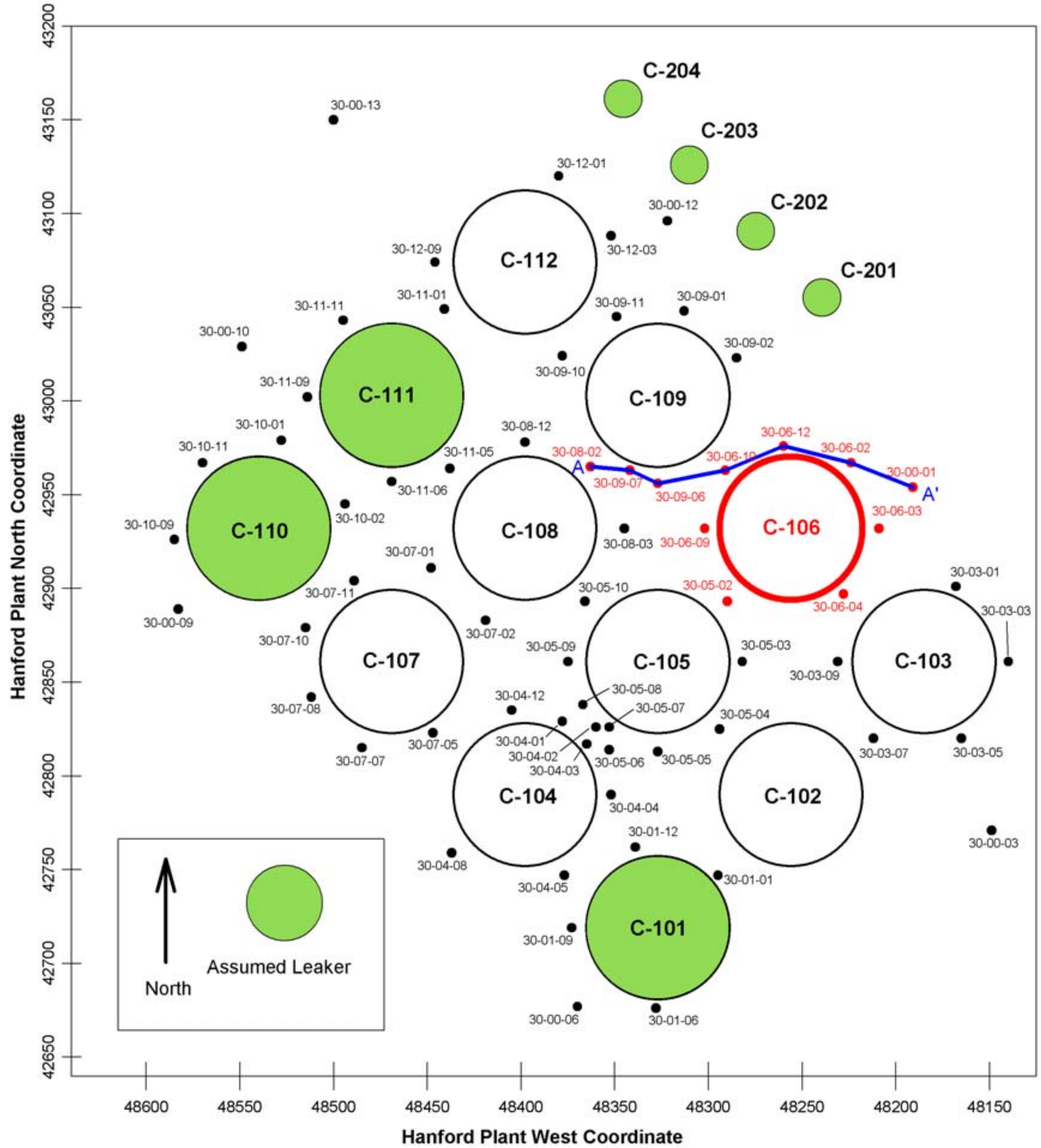


C-204
C-203
C-202
C-201
C-112
C-111
C-109
C-110
C-108
C-106
C-107
C-105
C-103
C-104
C-102
C-101
A
A'
North
Assumed Leaker
Hanford Plant North Coordinate
Hanford Plant West Coordinate

Figure 1

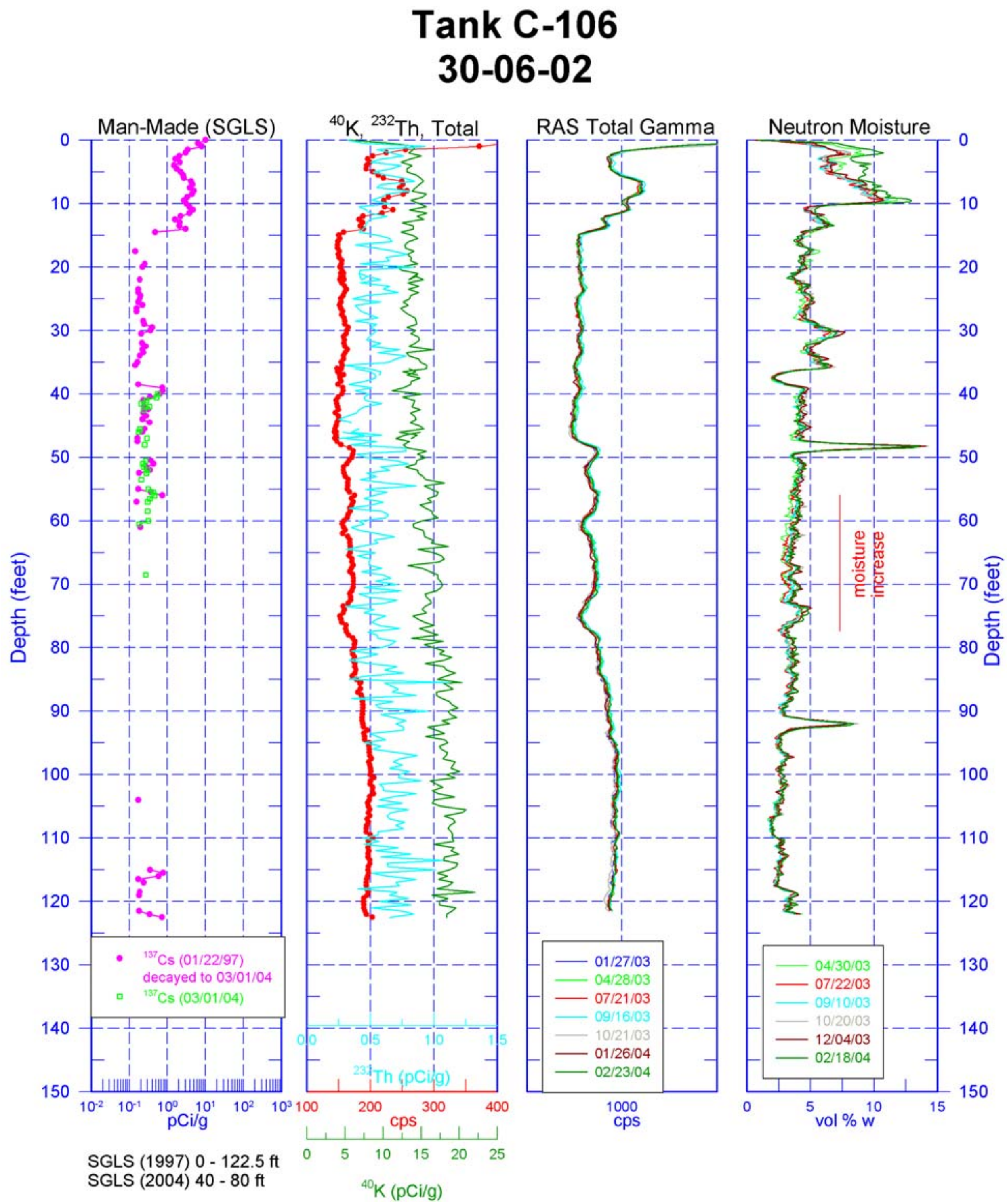
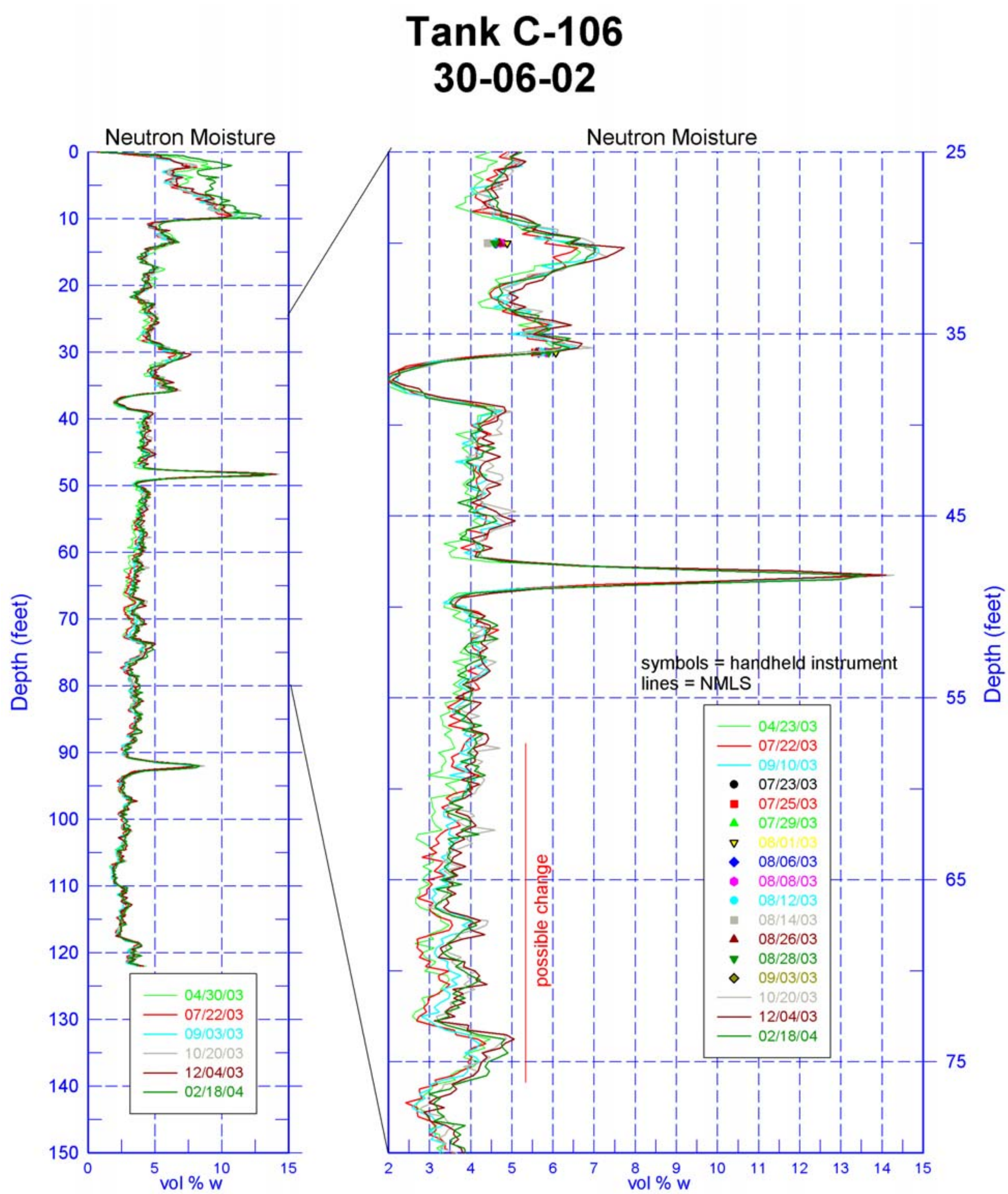

Tank C-106
30-06-02
Man-Made (SGLS)
40K, 232Th, Total
RAS Total Gamma
Neutron Moisture
Depth (feet)
137Cs (01/22/97) decayed to 03/01/04
137Cs (03/01/04)
pCi/g
SGLS (1997) 0 - 122.5 ft
SGLS (2004) 40 - 80 ft
232Th (pCi/g)
cps
40K (pCi/g)
01/27/03
04/28/03
07/21/03
09/16/03
10/21/03
01/26/04
02/23/04
cps
04/30/03
07/22/03
09/10/03
10/20/03
12/04/03
02/18/04
moisture increase
vol % w

Figure 2a



Tank C-106
30-06-02
Neutron Moisture
Neutron Moisture
Depth (feet)
vol % w
symbols = handheld instrument
lines = NMLS
possible change
04/30/03
07/22/03
09/03/03
10/20/03
12/04/03
02/18/04
04/23/03
07/22/03
09/10/03
07/23/03
07/25/03
07/29/03
08/01/03
08/06/03
08/08/03
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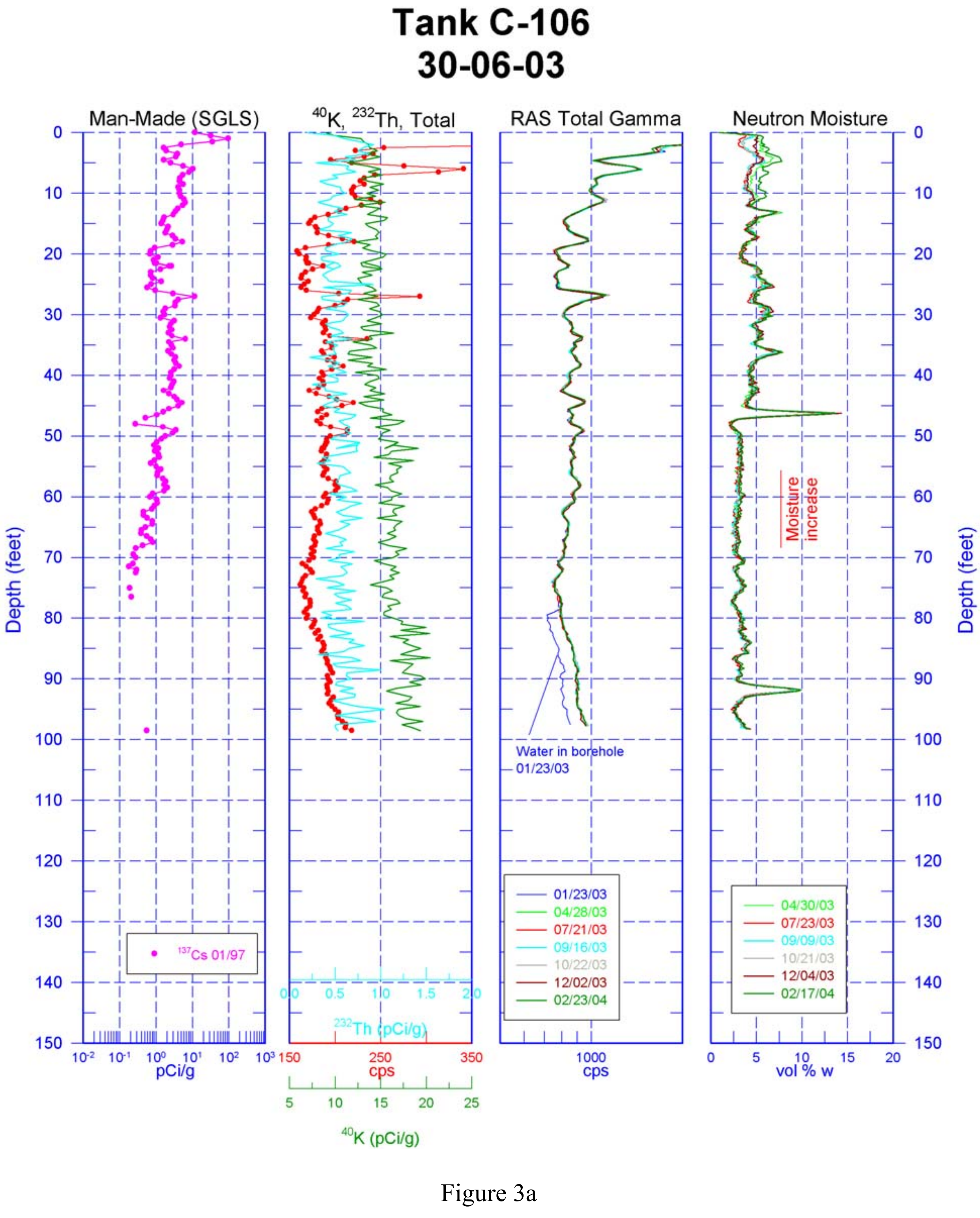
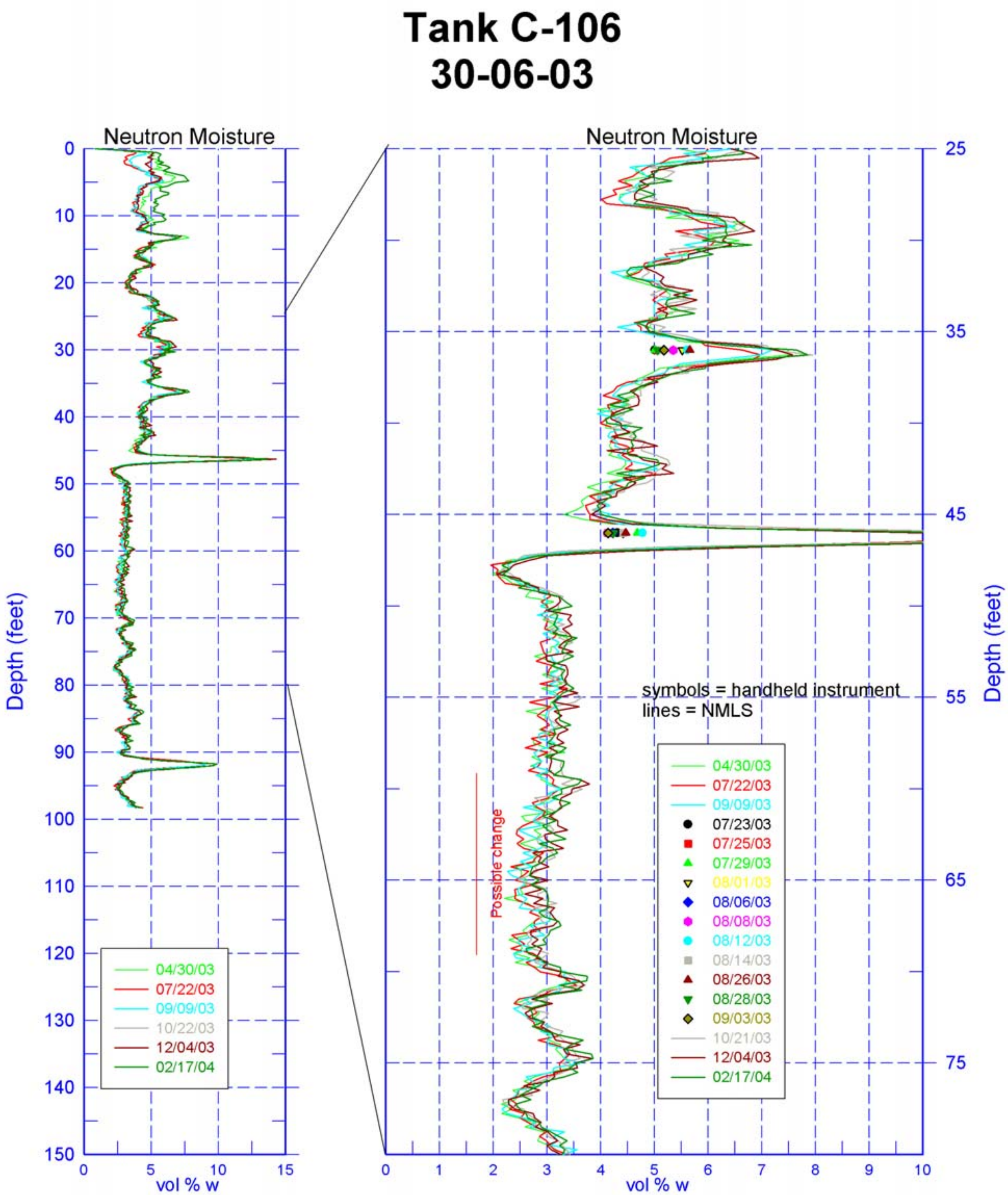
12/04/03
02/18/04

Figure 2b



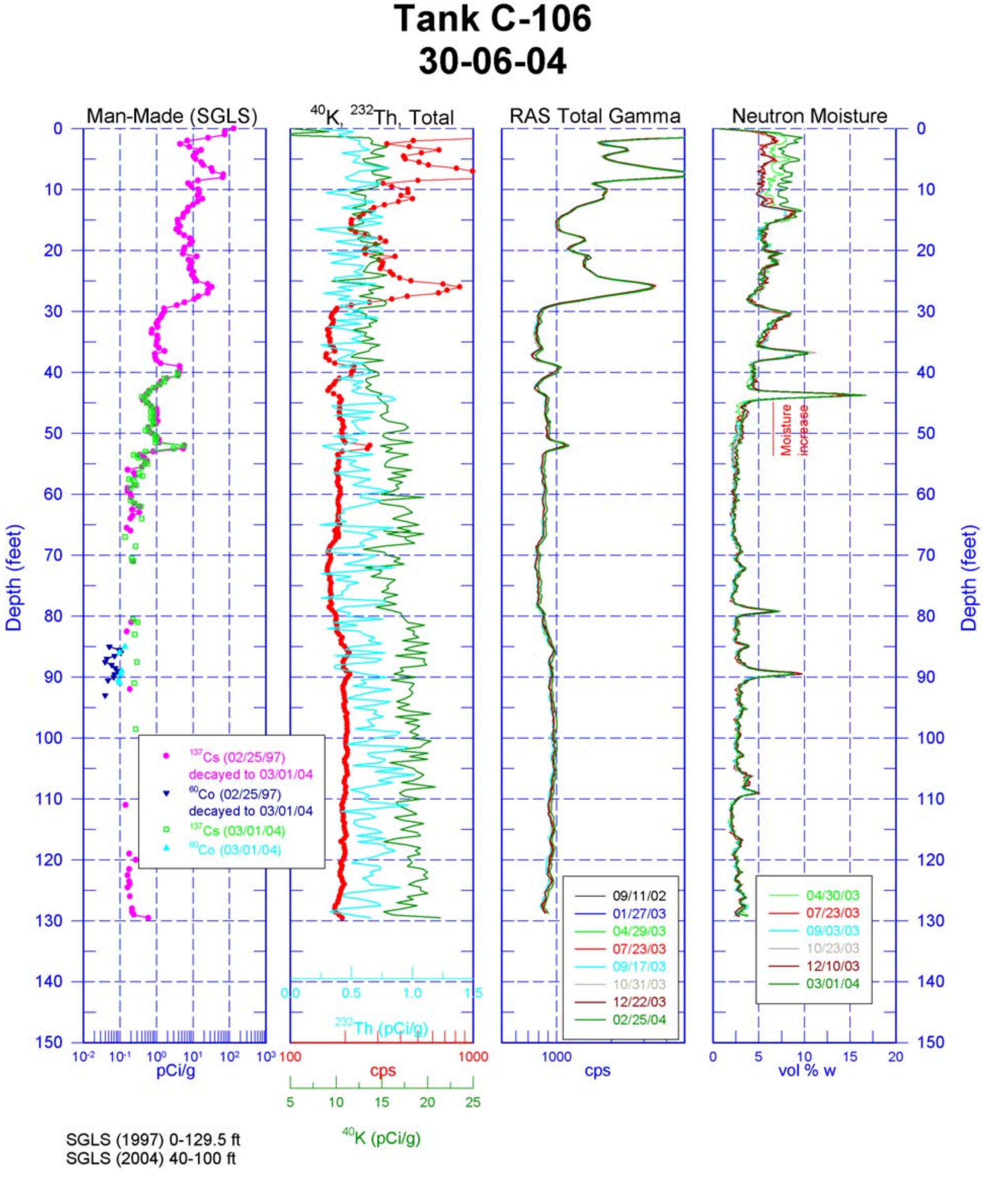
Tank C-106
30-06-03
Man-Made (SGLS)
40K, 232Th, Total
RAS Total Gamma
Neutron Moisture
Depth (feet)
137Cs 01/97
pCi/g
232Th (pCi/g)
cps
40K (pCi/g)
Water in borehole
01/23/03
01/23/03
04/28/03
07/21/03
09/16/03
10/22/03
12/02/03
02/23/04
Moisture
increase
04/30/03
07/23/03
09/09/03
10/21/03
12/04/03
02/17/04
vol % w

Figure 3a



Tank C-106
30-06-03
Neutron Moisture
Depth (feet)
vol % w
04/30/03
07/22/03
09/09/03
10/22/03
12/04/03
02/17/04
symbols = handheld instrument
lines = NMLS
Possible change
07/23/03
07/25/03
07/29/03
08/01/03
08/06/03
08/08/03
08/12/03
08/14/03
08/26/03
08/28/03
09/03/03
10/21/03

Figure 3b



Tank C-106
30-06-04
Man-Made (SGLS)
^{40}K, ^{232}Th, Total
RAS Total Gamma
Neutron Moisture
Depth (feet)
Moisture increase
^{137}Cs (02/25/97) decayed to 03/01/04
^{60}Co (02/25/97) decayed to 03/01/04
^{137}Cs (03/01/04)
^{60}Co (03/01/04)
09/11/02
01/27/03
04/29/03
07/23/03
09/17/03
10/31/03
12/22/03
02/25/04
04/30/03
07/23/03
09/03/03
10/23/03
12/10/03
03/01/04
pCi/g
^{232}Th (pCi/g)
cps
^{40}K (pCi/g)
cps
vol % w
SGLS (1997) 0-129.5 ft
SGLS (2004) 40-100 ft

Figure 4a

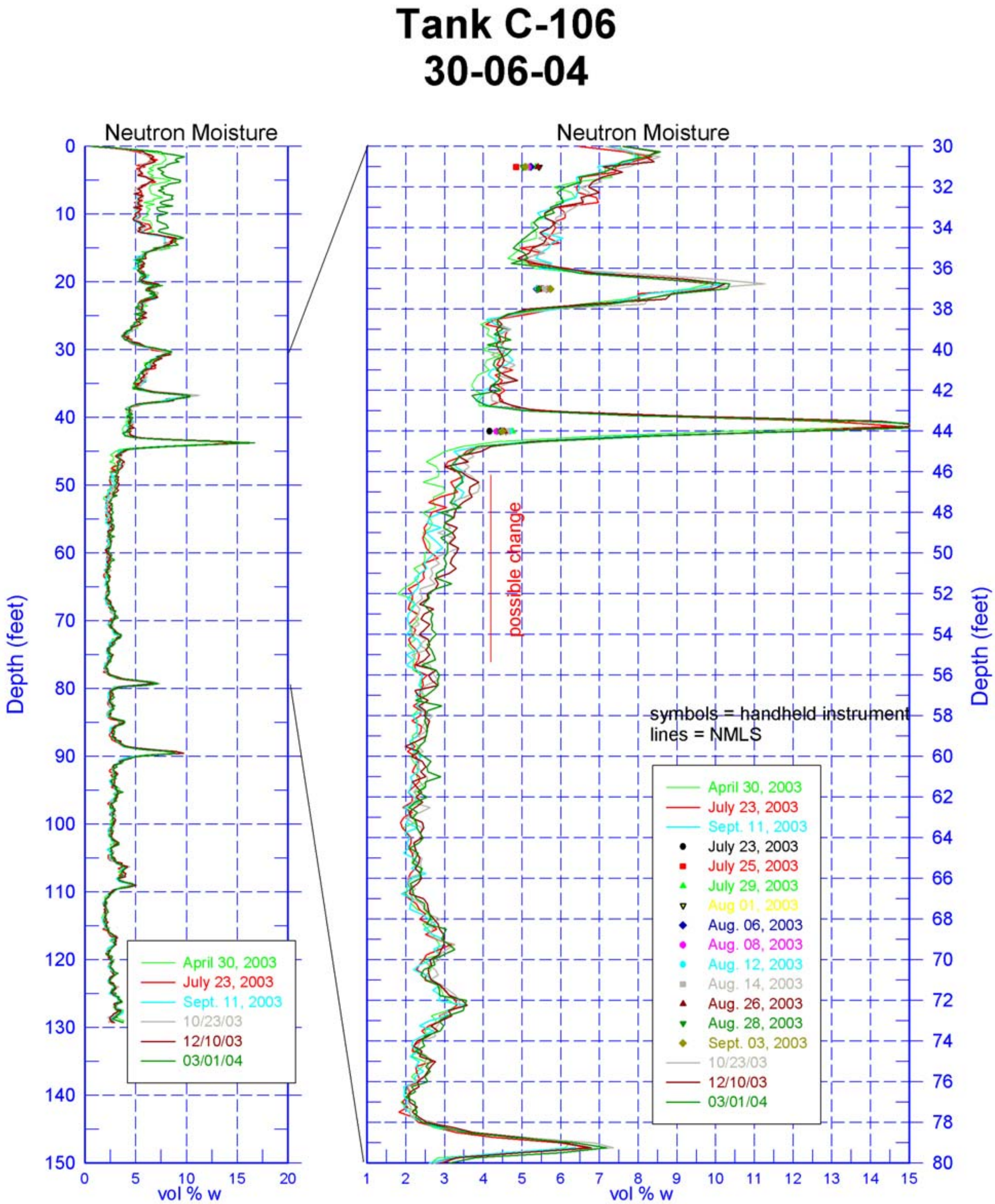

Tank C-106
30-06-04
Neutron Moisture
Depth (feet)
vol % w
April 30, 2003
July 23, 2003
Sept. 11, 2003
10/23/03
12/10/03
03/01/04
Neutron Moisture
possible change
symbols = handheld instrument
lines = NMLS
April 30, 2003
July 23, 2003
Sept. 11, 2003
July 23, 2003
July 25, 2003
July 29, 2003
Aug 01, 2003
Aug. 06, 2003
Aug. 08, 2003
Aug. 12, 2003
Aug. 14, 2003
Aug. 26, 2003
Aug. 28, 2003
Sept. 03, 2003
10/23/03
12/10/03
03/01/04
Depth (feet)
vol % w

Figure 4b

Tank C-106
30-06-04

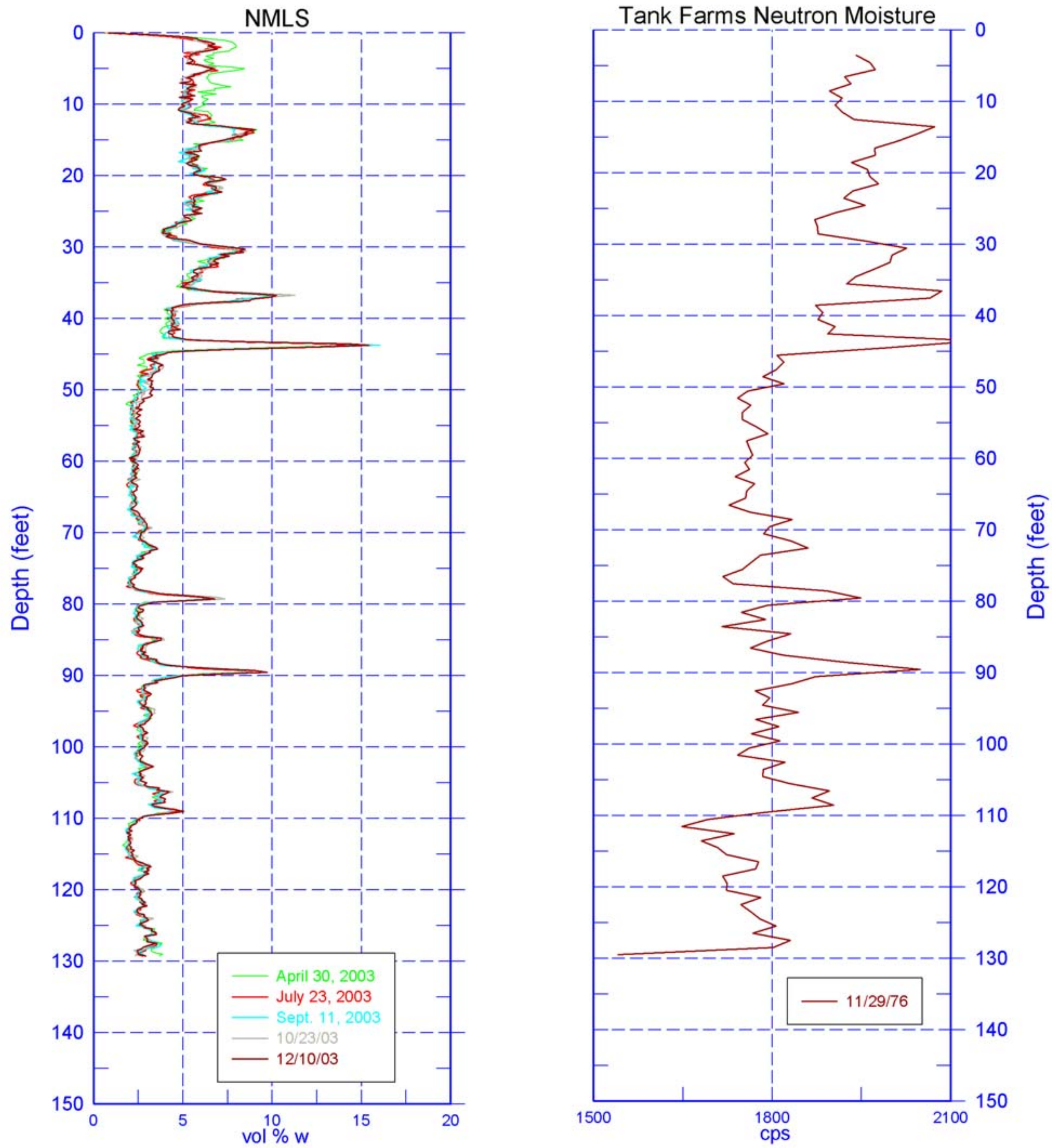
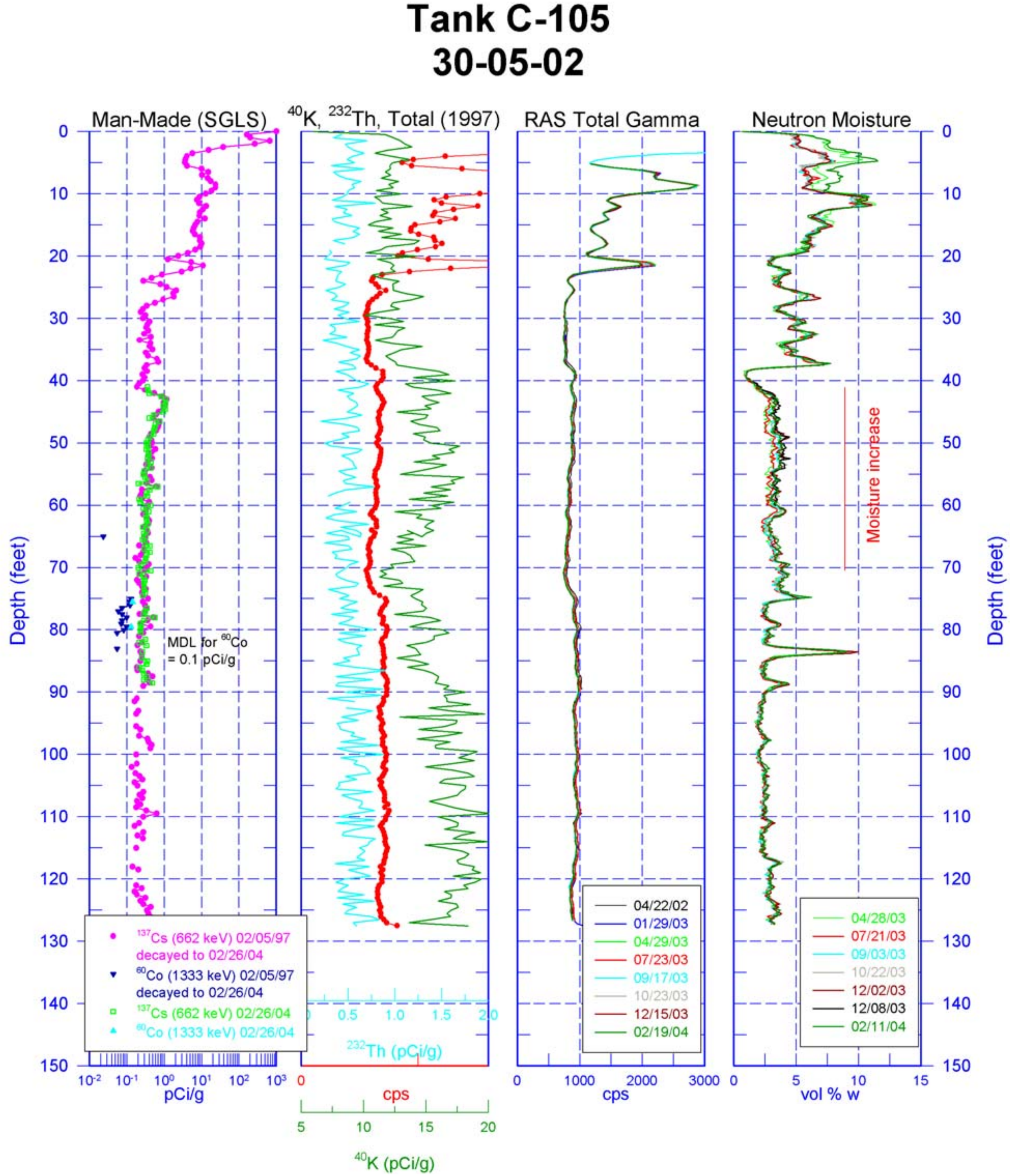


Figure 4c



Tank C-105
30-05-02
Man-Made (SGLS)
40K, 232Th, Total (1997)
RAS Total Gamma
Neutron Moisture
Depth (feet)
MDL for 60Co = 0.1 pCi/g
137Cs (662 keV) 02/05/97 decayed to 02/26/04
60Co (1333 keV) 02/05/97 decayed to 02/26/04
137Cs (662 keV) 02/26/04
60Co (1333 keV) 02/26/04
pCi/g
232Th (pCi/g)
cps
40K (pCi/g)
04/22/02
01/29/03
04/29/03
07/23/03
09/17/03
10/23/03
12/15/03
02/19/04
Moisture increase
04/28/03
07/21/03
09/03/03
10/22/03
12/02/03
12/08/03
02/11/04
vol % w

Figure 5a

Tank C-105
30-05-02

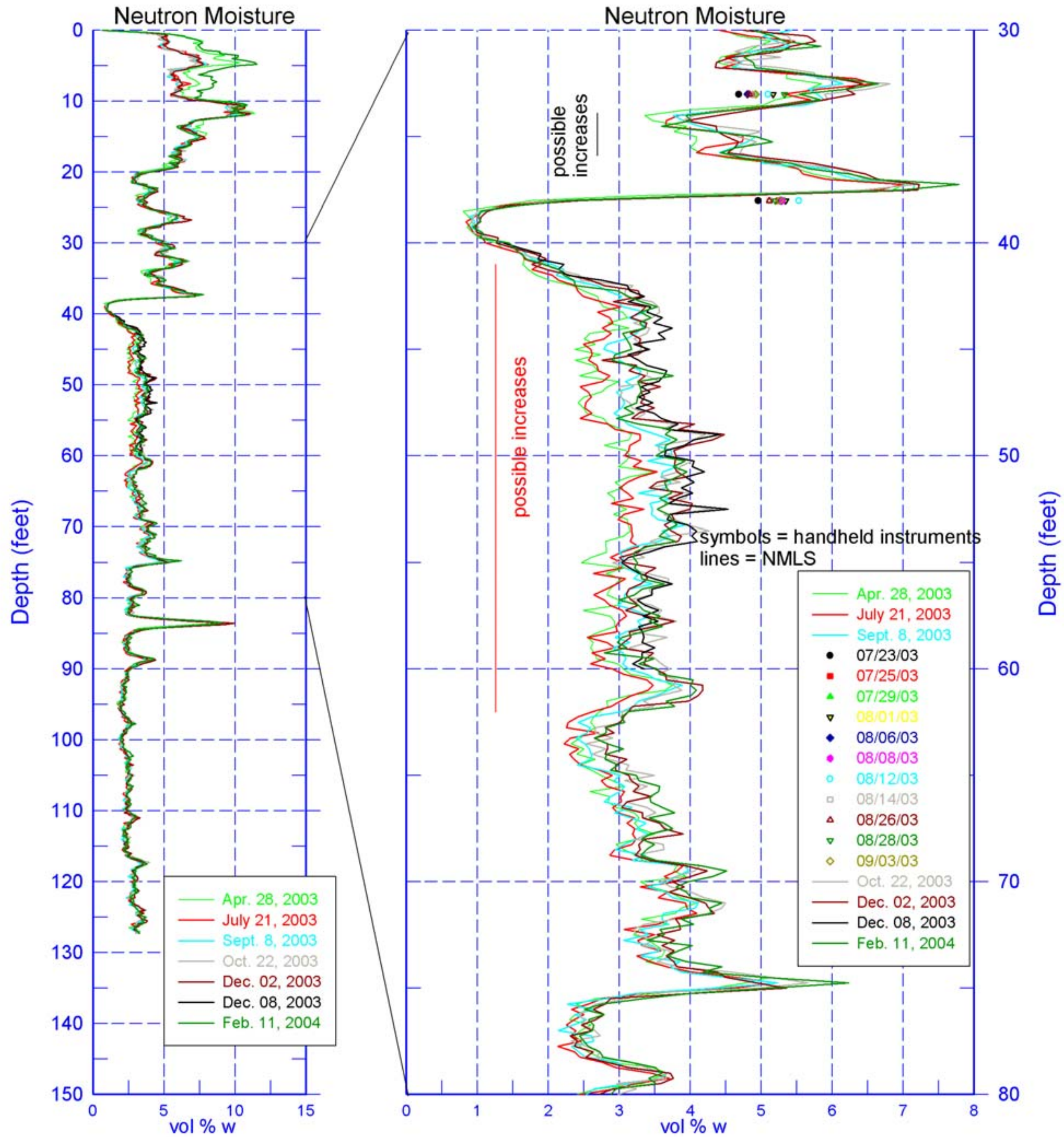


Figure 5b

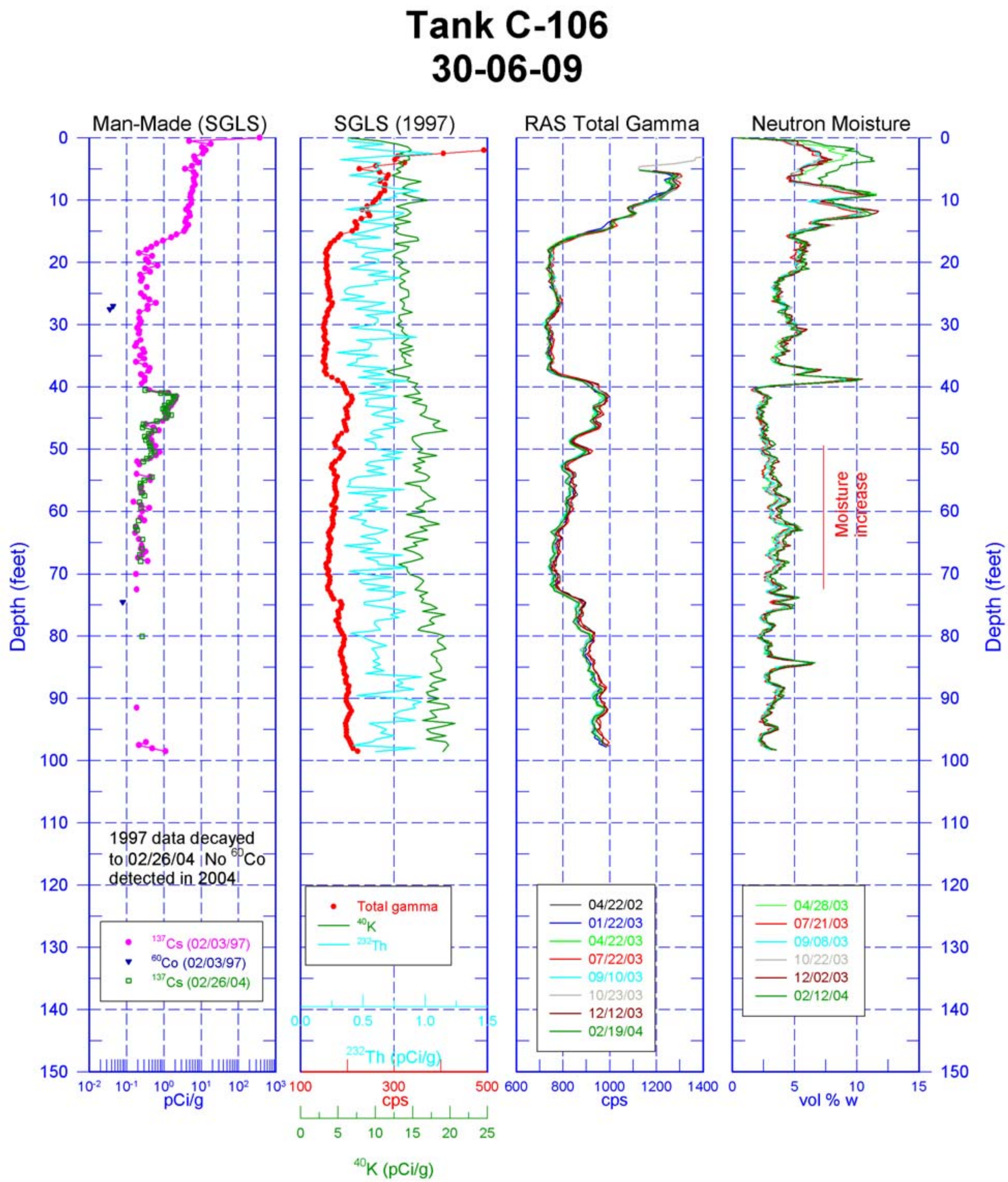
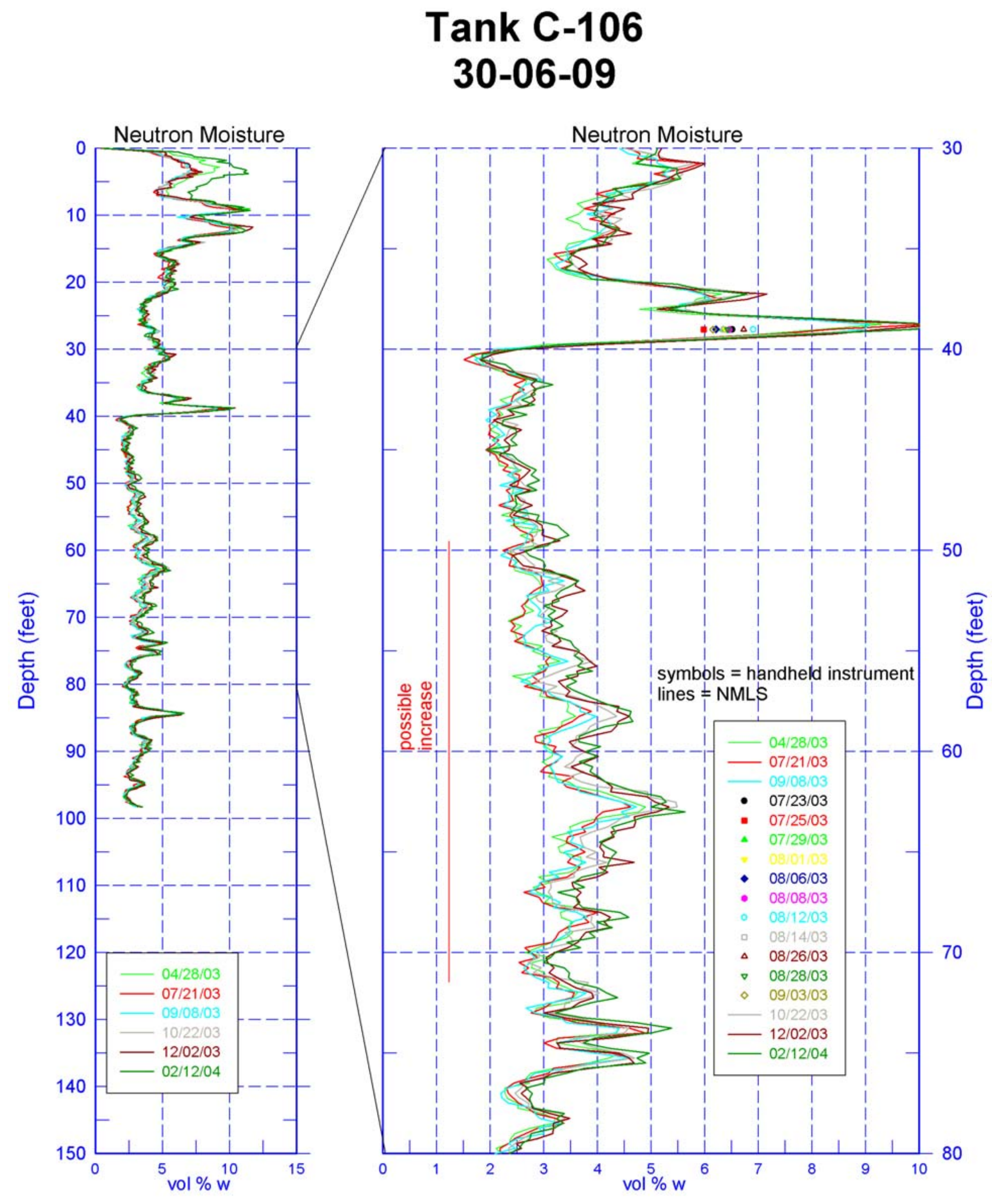
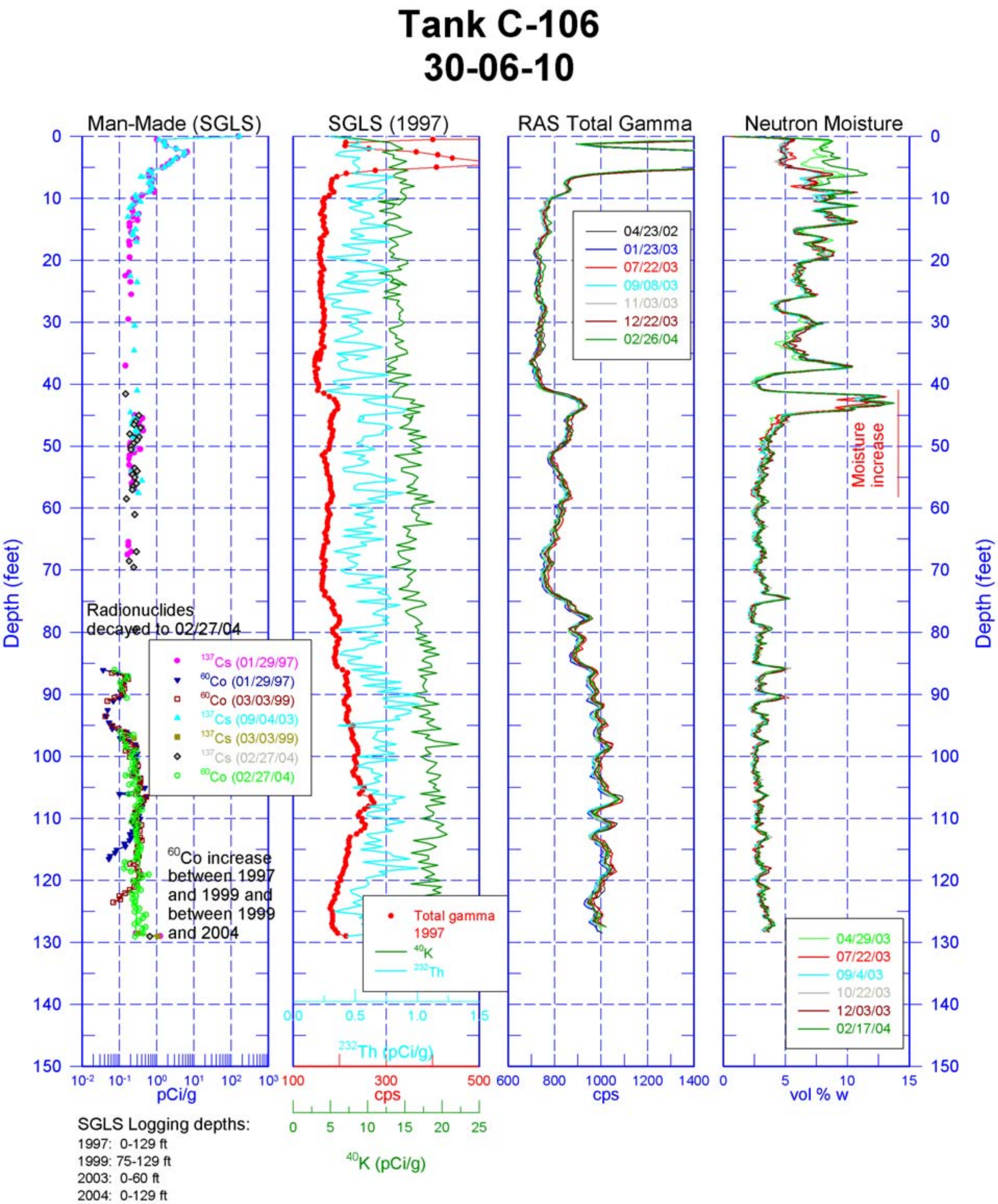

Tank C-106
30-06-09
Man-Made (SGLS)
SGLS (1997)
RAS Total Gamma
Neutron Moisture
Depth (feet)
1997 data decayed to 02/26/04. No 60Co detected in 2004
137Cs (02/03/97)
60Co (02/03/97)
137Cs (02/26/04)
pCi/g
Total gamma
40K
232Th
232Th (pCi/g)
cps
40K (pCi/g)
04/22/02
01/22/03
04/22/03
07/22/03
09/10/03
10/23/03
12/12/03
02/19/04
cps
Moisture increase
04/28/03
07/21/03
09/08/03
10/22/03
12/02/03
02/12/04
vol % w

Figure 6a



Tank C-106
30-06-09
Neutron Moisture
Depth (feet)
vol % w
Neutron Moisture
Depth (feet)
vol % w
possible increase
symbols = handheld instrument
lines = NMLS
04/28/03
07/21/03
09/08/03
07/23/03
07/25/03
07/29/03
08/01/03
08/06/03
08/08/03
08/12/03
08/14/03
08/26/03
08/28/03
09/03/03
10/22/03
12/02/03
02/12/04

Figure 6b



Tank C-106
30-06-10
Man-Made (SGLS)
SGLS (1997)
RAS Total Gamma
Neutron Moisture
Depth (feet)
Radionuclides decayed to 02/27/04
137Cs (01/29/97)
60Co (01/29/97)
60Co (03/03/99)
137Cs (09/04/03)
137Cs (03/03/99)
137Cs (02/27/04)
60Co (02/27/04)
60Co increase between 1997 and 1999 and between 1999 and 2004
pCi/g
SGLS Logging depths:
1997: 0-129 ft
1999: 75-129 ft
2003: 0-60 ft
2004: 0-129 ft
Total gamma 1997
40K
232Th
232Th (pCi/g)
cps
40K (pCi/g)
04/23/02
01/23/03
07/22/03
09/08/03
11/03/03
12/22/03
02/26/04
Moisture increase
04/29/03
07/22/03
09/4/03
10/22/03
12/03/03
02/17/04
vol % w

Figure 7a

Tank C-106
30-06-10

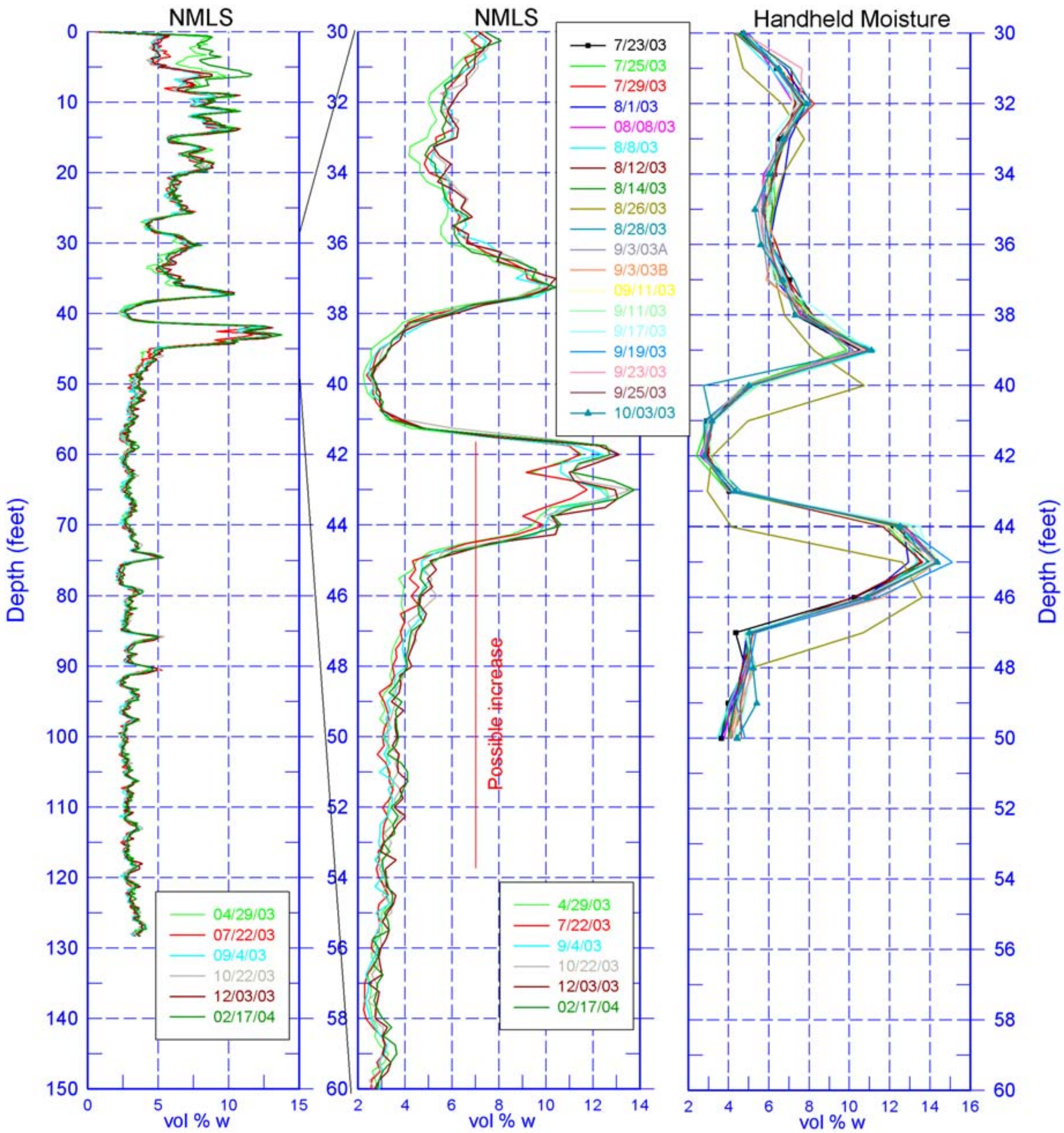


Figure 7b

Tank C-106
30-06-12

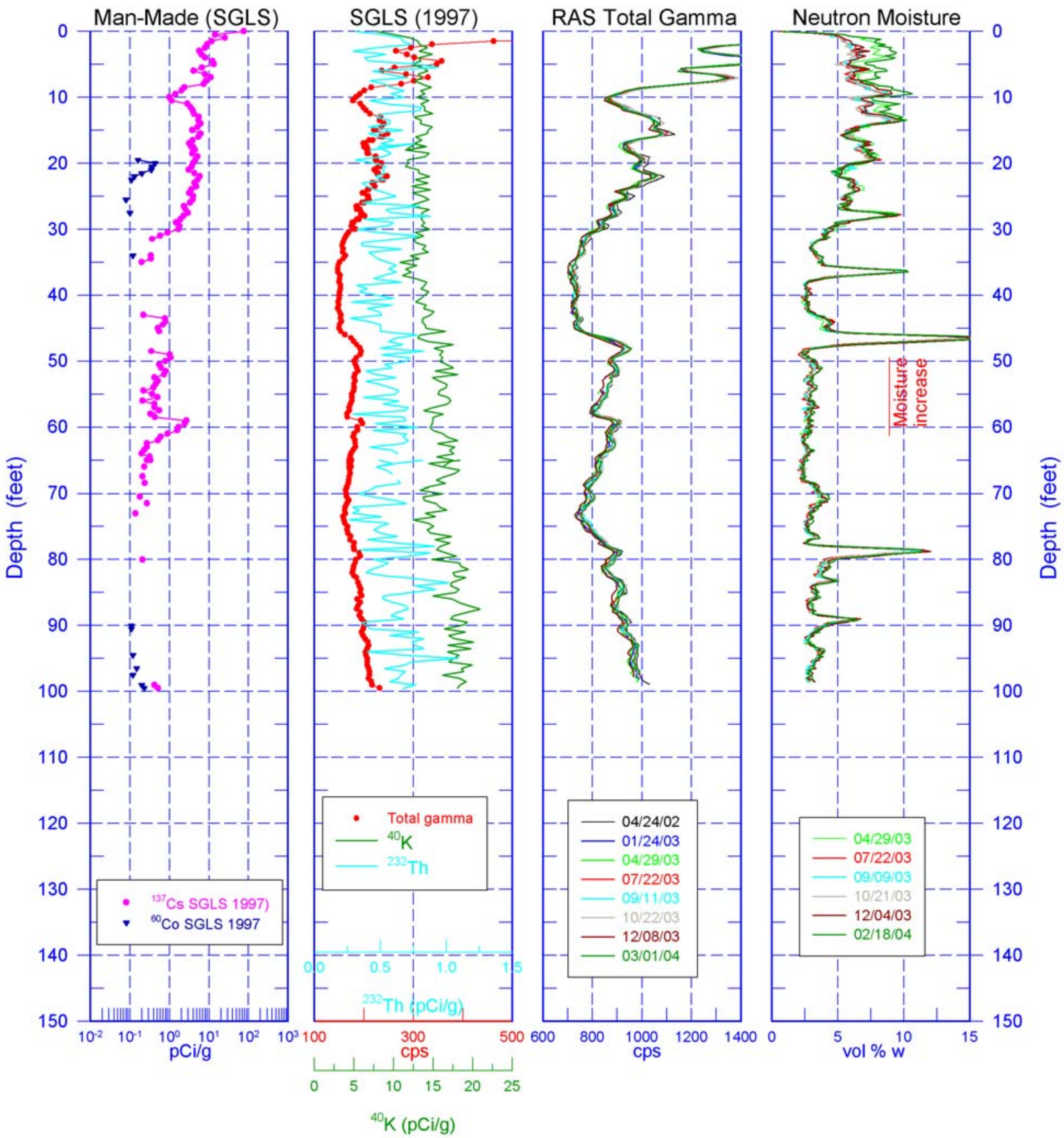


Figure 8a

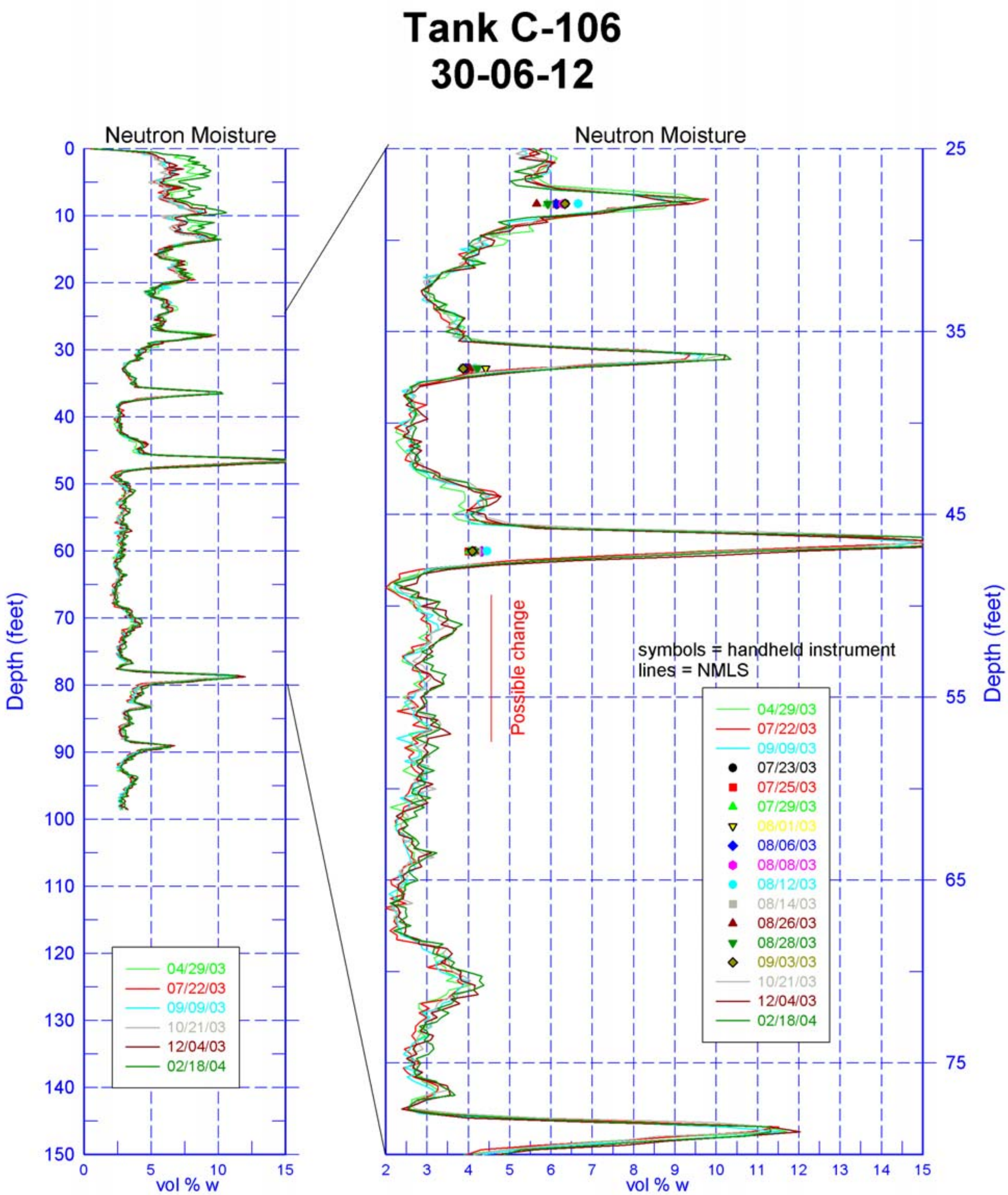

Tank C-106
30-06-12
Neutron Moisture
Depth (feet)
vol % w
04/29/03
07/22/03
09/09/03
10/21/03
12/04/03
02/18/04
Neutron Moisture
Possible change
symbols = handheld instrument
lines = NMLS
04/29/03
07/22/03
09/09/03
07/23/03
07/25/03
07/29/03
08/01/03
08/06/03
08/08/03
08/12/03
08/14/03
08/26/03
08/28/03
09/03/03
10/21/03
12/04/03
02/18/04
Depth (feet)
vol % w

Figure 8b

Tank C-108
30-08-02

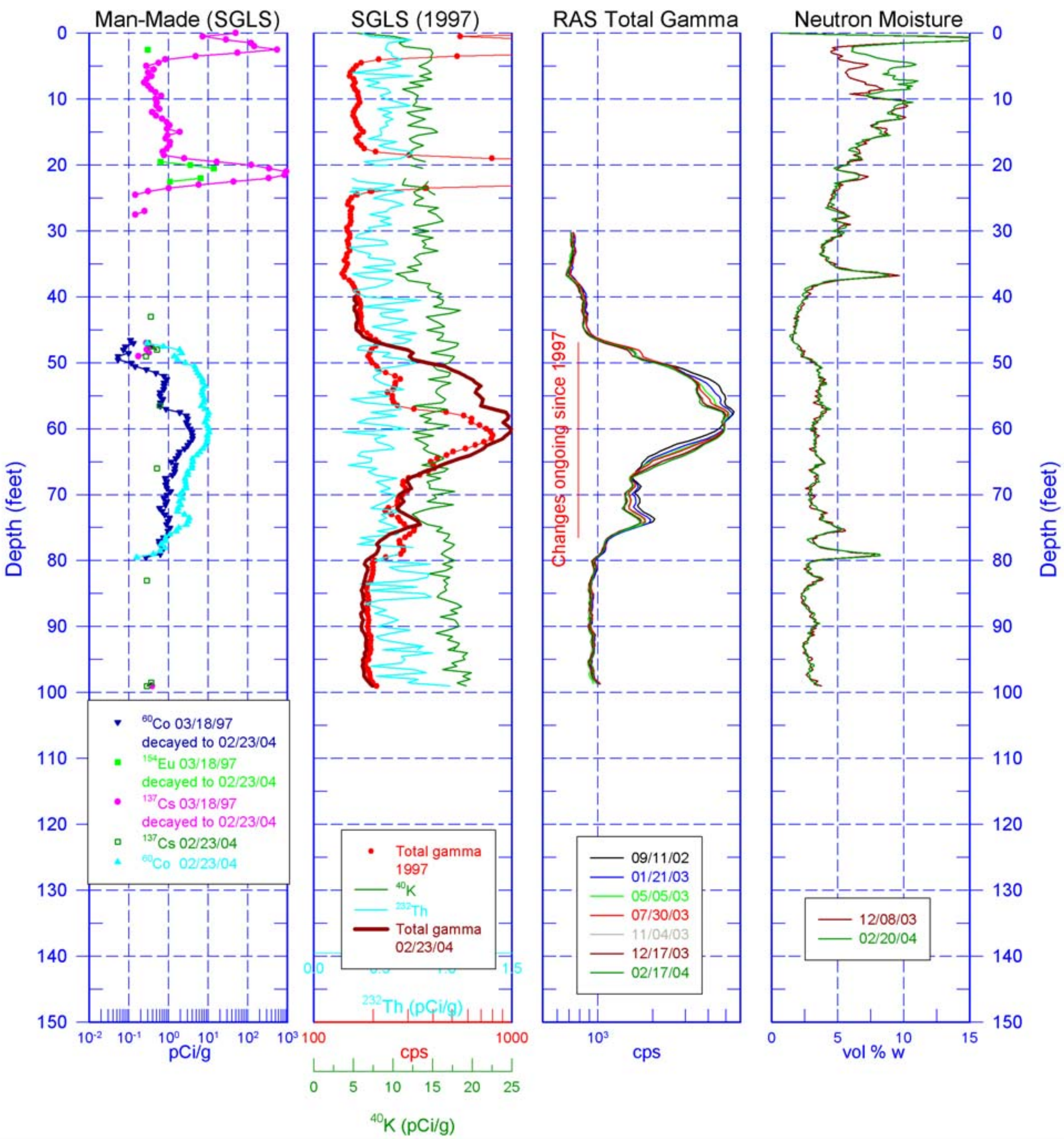


Figure 9a

Tank C-108
30-08-02

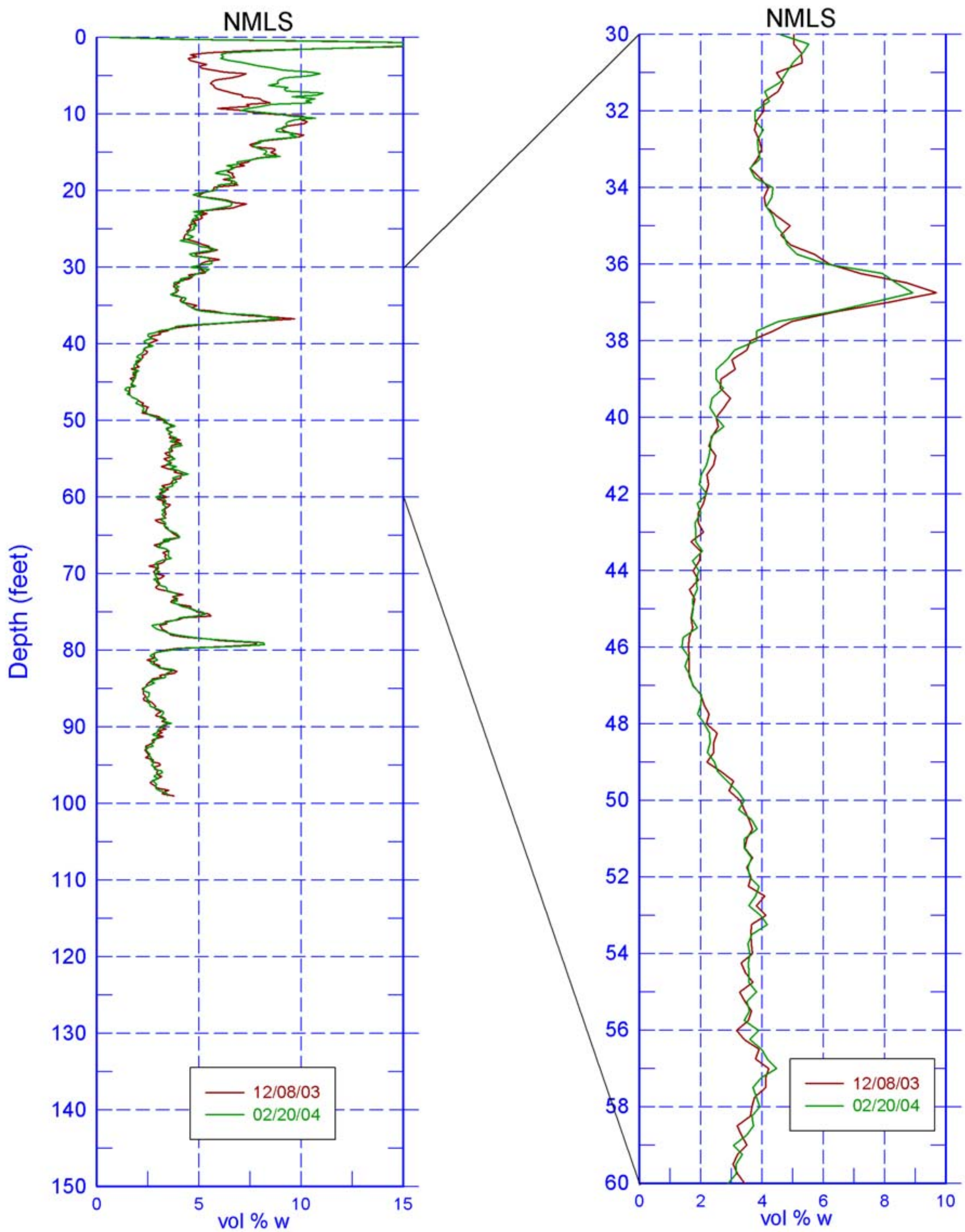


Figure 9b

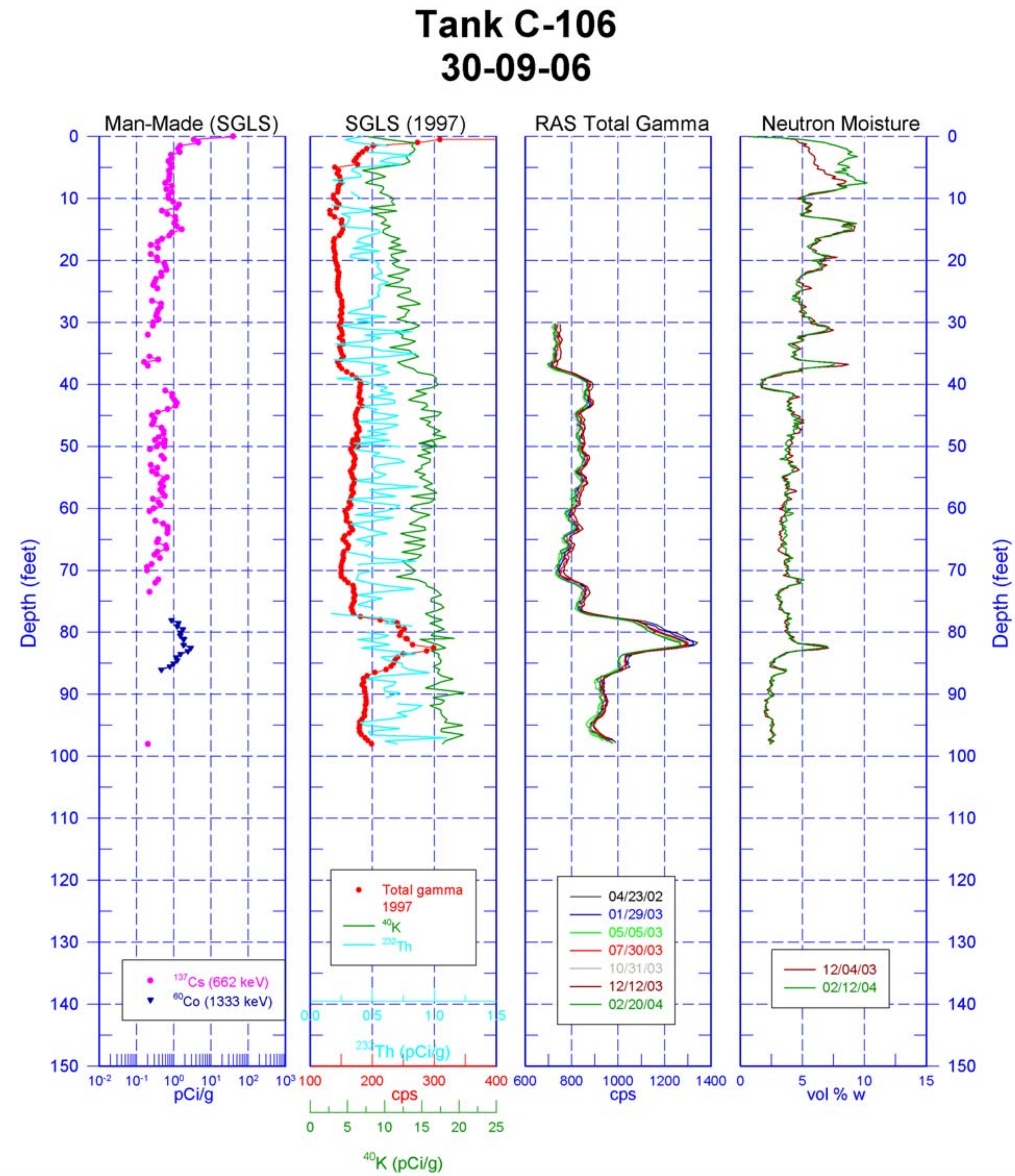

Tank C-106
30-09-06
Man-Made (SGLS)
SGLS (1997)
RAS Total Gamma
Neutron Moisture
Depth (feet)
137Cs (662 keV)
60Co (1333 keV)
Total gamma 1997
40K
232Th
04/23/02
01/29/03
05/05/03
07/30/03
10/31/03
12/12/03
02/20/04
12/04/03
02/12/04
pCi/g
cps
232Th (pCi/g)
40K (pCi/g)
vol % w

Figure 10a

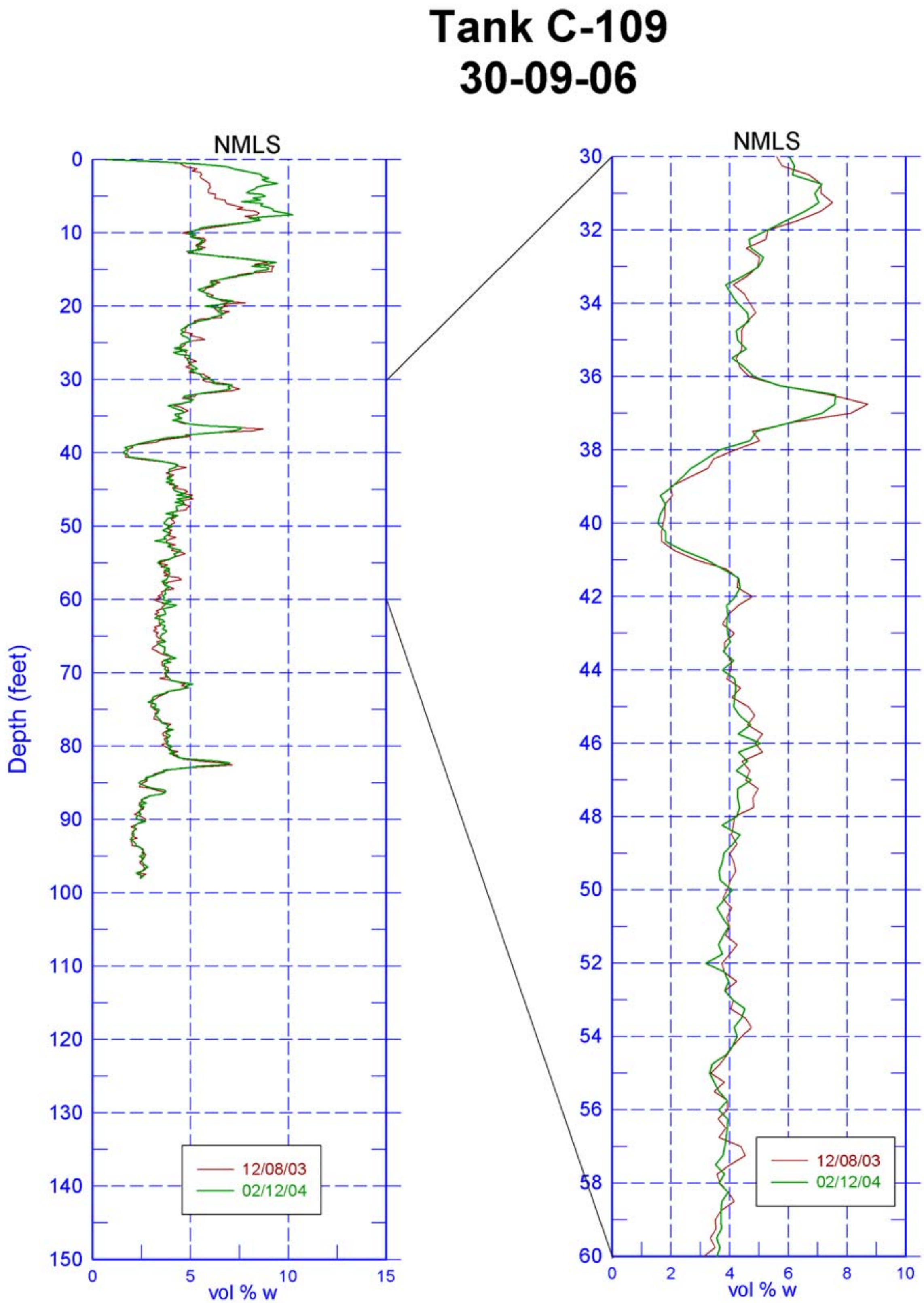

Tank C-109
30-09-06
NMLS
Depth (feet)
vol % w
12/08/03
02/12/04
NMLS
vol % w
12/08/03
02/12/04

Figure 10b

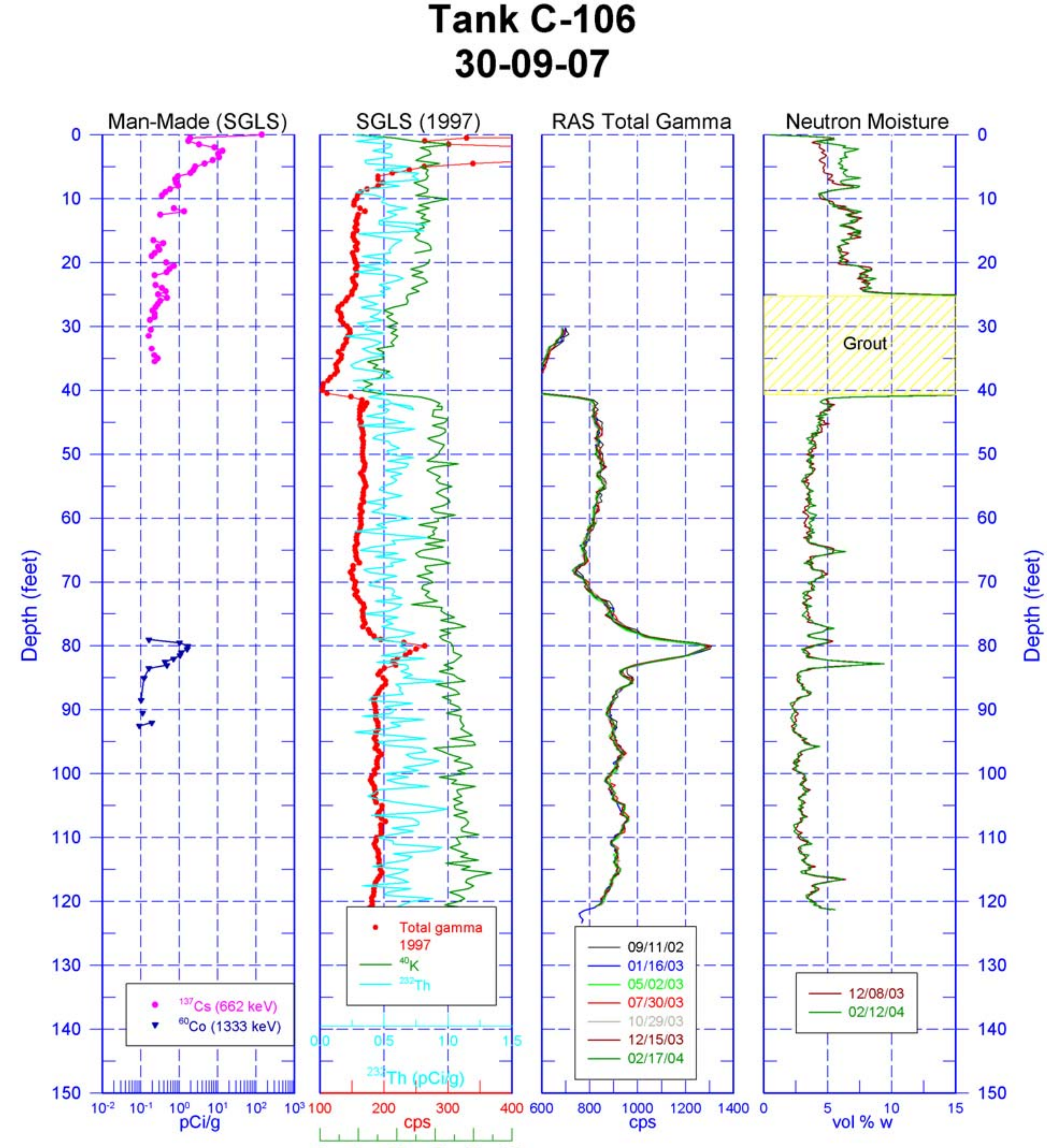

Tank C-106
30-09-07
Man-Made (SGLS)
SGLS (1997)
RAS Total Gamma
Neutron Moisture
Depth (feet)
Grout
137Cs (662 keV)
60Co (1333 keV)
Total gamma 1997
40K
232Th
09/11/02
01/16/03
05/02/03
07/30/03
10/29/03
12/15/03
02/17/04
12/08/03
02/12/04
pCi/g
cps
232Th (pCi/g)
40K (pCi/g)
vol % w

Figure 11a

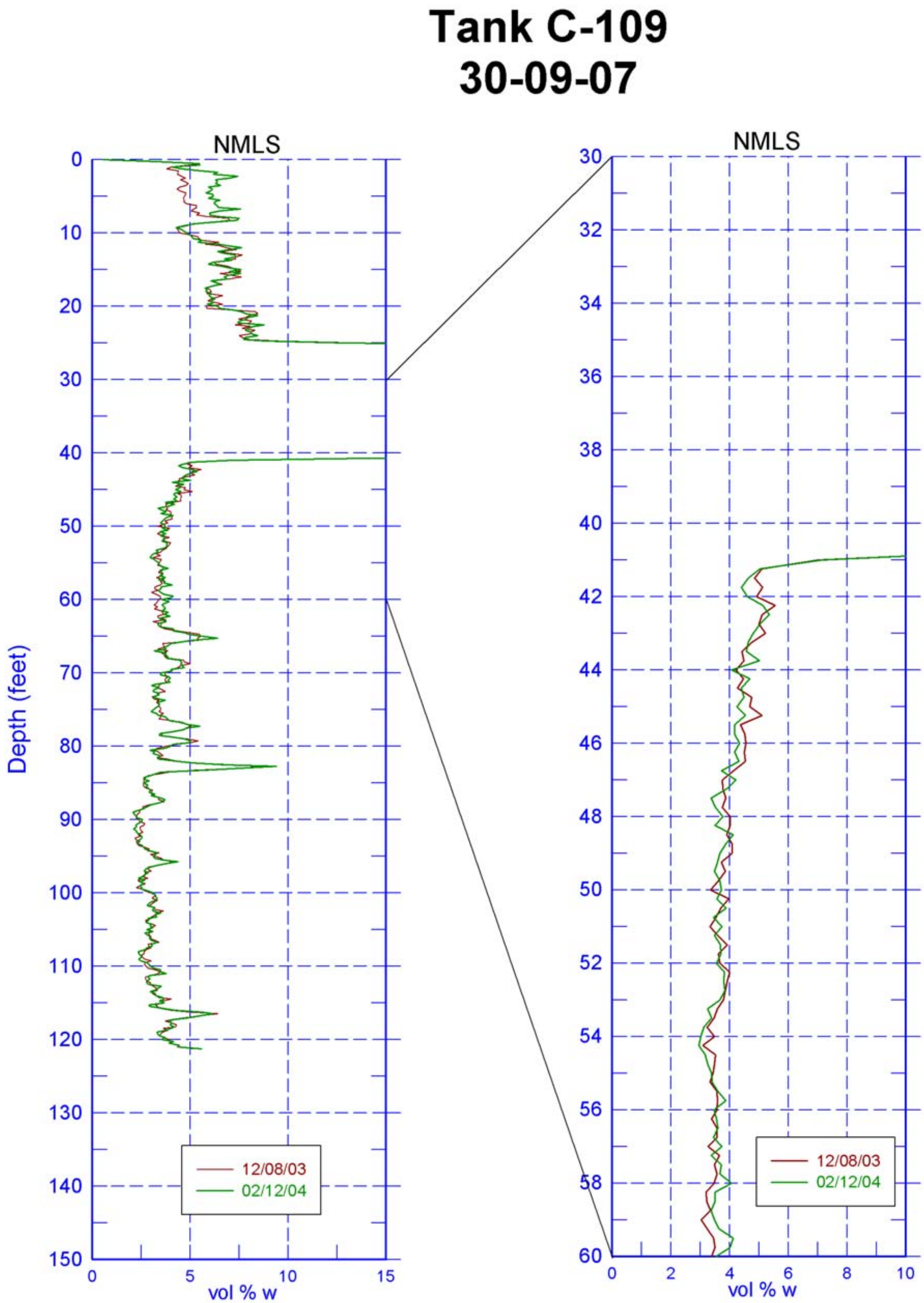
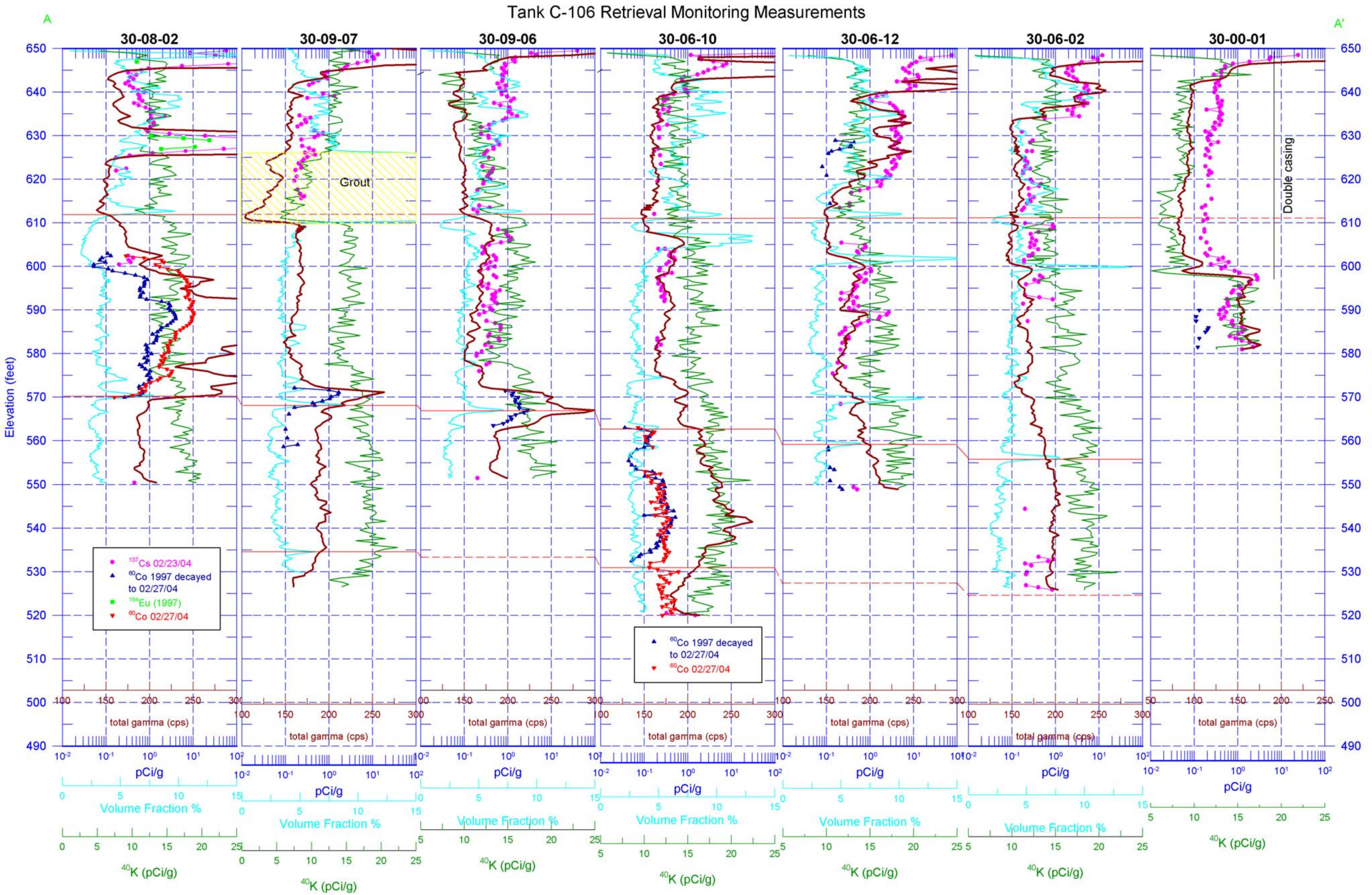

Tank C-109
30-09-07
NMLS
Depth (feet)
vol % w
12/08/03
02/12/04
NMLS
vol % w
12/08/03
02/12/04

Figure 11b



Tank C-106 Retrieval Monitoring Measurements
A
A'
30-08-02
30-09-07
30-09-06
30-06-10
30-06-12
30-06-02
30-00-01
Elevation (feet)
Grout
Double casing
137Cs 02/23/04
60Co 1997 decayed to 02/27/04
154Eu (1997)
60Co 02/27/04
total gamma (cps)
pCi/g
Volume Fraction %
40K (pCi/g)

Figure 12

Appendix C
241-C-105 Characterization Borehole C4297

Stoller
Hanford Office

DOE-EM/GJ622-2004

C4297
Log Data Report

Borehole Information:

Borehole:	C4297		Site:	241-C-105	
Coordinates (Hanford Plant)		GWL (ft)[1]: Dry		GWL Date:	03/23/04
North	West	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
42819.84 ft	48359.79	03/04	Not Available	196.5	Percussion

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.7	10 3/4	9 3/4	1/2	0	152.09
Threaded Steel	3.7	8 5/8	7 5/8	1/2	0	195.58

Borehole Notes:

Casing, drilling, and groundwater information were provided by the driller. The casing thickness of 0.5 in. was confirmed by e-mail from David Myers of CH2M HILL. The coordinates were also provided by CH2M HILL. Logging data acquisition is referenced to the ground surface.

Logging Equipment Information:

Logging System:	Gamma 1E		Type:	SGLS (70%) SN: 34TP40587A
Calibration Date:	01/04	Calibration Reference:	GJO-2004-568-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 2A		Type:	SGLS (35%)
Calibration Date:	03/04	Calibration Reference:	Not yet available	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 2F		Type:	NMLS (SN: H380932510)
Calibration Date:	09/03	Calibration Reference:	GJO-2003-520-TAC	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	3	4	5 Repeat	6	7
Date	03/03/04	03/03/04	03/03/04	03/19/04	03/19/04
Logging Engineer	Spatz	Spatz	Spatz	Spatz	Spatz
Start Depth (ft)	149.43	149.0	50.0	194.62	194.0

Log Run	3	4	5 Repeat	6	7
Finish Depth (ft)	149.93	0.0	35.0	194.62	145.0
Count Time (sec)	100	100	100	200	200
Live/Real	R	R	R	R	R
Shield (Y/N)	N	N	N	N	N
MSA Interval (ft)	None	1	1	None	1
ft/min	N/A[2]	N/A	N/A	N/A	N/A
Pre-Verification	AE098CAB	AE098CAB	AE098CAB	BA317CAB	BA317CAB
Start File	AE098000	AE098001	AE098151	BA317000	BA317001
Finish File	AE098000	AE098150	AE098166	BA317000	BA317050
Post-Verification	AE098CAA	AE098CAA	AE098CAA	BA317CAA	BA317CAA
Depth Return Error (in.)	N/A	-1	0	N/A	N/A
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.	Fine-gain adjustment after: BA317003, -010, -022.

Log Run	8 Repeat				
Date	03/19/04				
Logging Engineer	Spatz				
Start Depth (ft)	160.0				
Finish Depth (ft)	155.0				
Count Time (sec)	200				
Live/Real	R				
Shield (Y/N)	N				
MSA Interval (ft)	1				
ft/min	N/A				
Pre-Verification	BA317CAB				
Start File	BA317051				
Finish File	BA317056				
Post-Verification	BA317CAA				
Depth Return Error (in.)	-0.25				
Comments	No fine-gain adjustment.				

Neutron Moisture Logging System (NMLS) Log Run Information:

Log Run	1	2 Repeat	9	10 Repeat	
Date	03/02/04	03/02/04	03/23/04	03/23/04	
Logging Engineer	Spatz	Spatz	Pearson	Pearson	
Start Depth (ft)	0.0	80.0	145.0	157.0	
Finish Depth (ft)	95.0	149.25	194.5	162.0	
Count Time (sec)	N/A	N/A	N/A	N/A	
Live/Real	N/A	N/A	N/A	N/A	
Shield (Y/N)	N/A	N/A	N/A	N/A	
Sample Interval (ft)	0.25	0.25	0.25	0.25	
ft/min	1.0	1.0	1.0	1.0	
Pre-Verification	BF161CAB	BF161CAB	BF162CAB	BF162CAB	
Start File	BF161000	BF161381	BF162000	BF162199	
Finish File	BF161380	BF161658	BF162198	BF162219	
Post-Verification	BF161CAA	BF161CAA	BF162CAA	BF162CAA	
Depth Return Error (in.)	N/A	+0.5	N/A	+.05	
Comments	No fine-gain adjustment.	Repeat 80-95 ft.	No fine-gain adjustment.	No fine-gain adjustment.	

Logging Operation Notes:

Spectral gamma and moisture logging were performed in this borehole during March 2004 on four separate days. SGLS G1E was used for logging runs 3, 4, and 5 and G2A for log runs 6, 7, and 8. Logging was conducted with a centralizer on the sonde. Logging measurements are referenced to ground surface. Repeat sections were collected in this borehole to evaluate system performance.

Analysis Notes:

Analyst:	Henwood	Date:	03/30/04	Reference:	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for each logging system were performed for each day's log event. The acceptance criteria were met for all logging systems.

A casing correction for 0.5-in.-thick casing was applied for the steel casing to the total depth of the borehole. The 0.5-in. casing wall thickness is provided by CH2M HILL.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with EXCEL worksheet templates identified as G2AFeb04.xls and G1EJan04.xls for the SGLSs, using efficiency functions and corrections for casing, water, and dead time as determined from annual calibrations. Dead time corrections are applied where dead times exceed 10.5 percent. Where SGLS dead time exceeds 40 percent, pulse pileup and peak spreading may occur in a spectrum that results in an underestimation of the concentration of man-made radionuclides. Dead time of 40 percent was exceeded in two depth intervals (13 and 14 ft). Because the interval of high dead time was thin, it was determined the HRLS could not be efficiently deployed to obtain data. No correction for water was necessary in this borehole.

NMLS log spectra were processed in batch mode using APTEC Supervisor to determine count rates. The volume fraction of water was not calculated because there is no valid calibration for a 10-in.-diameter borehole. However, increasing count rates are a reliable indicator of increasing moisture content.

Log Plot Notes:

Separate log plots are provided for the man-made radionuclides (^{137}Cs, ^{154}Eu, and ^{60}Co) detected in the borehole, naturally occurring radionuclides (^{40}K, ^{238}U, ^{232}Th [KUT]), a combination of man-made, KUT, and moisture, and total gamma plotted with dead time. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, casing corrections, or water corrections. Repeat log sections are also included.

Results and Interpretations:

^{137}Cs, ^{154}Eu, and ^{60}Co were the man-made radionuclides detected in this borehole. ^{137}Cs was detected between the ground surface and 19 ft in depth at concentrations between 0.3 and 1,700 pCi/g. ^{137}Cs was also detected at a few locations near its MDL of approximately 0.2 pCi/g.

^{60}Co was detected at 12 and 15 ft and between 40 ft and 65 ft. The maximum concentration measured was approximately 1 pCi/g at 15 ft.

^{154}Eu was detected between 11 and 16 ft. The maximum concentration measured was approximately 400 pCi/g at 13 ft.

The profile of the ^{137}Cs, ^{154}Eu, and ^{60}Co between approximately 11 and 16 ft is suggestive of a point source of contamination such as a pipeline. A 3-in. inlet line #V103 that connects to the southwest quadrant of tank C-105 lies a few feet northeast from the location of the borehole at a depth of 13.63 ft below grade. It is hypothesized that the log data reflect contamination inside this pipeline.

Recognizable changes in the KUT and total gamma logs occurred in this borehole. At 39 ft, there is a 3-pCi/g increase in ^{40}K concentration and a decrease in relative moisture content. This increase in apparent ^{40}K concentration corresponds with the base of the backfill. An interval between 40 and 65 ft appears to reflect alternating layers and mixtures of sand and gravel that coincide with the ^{60}Co contamination. At 65 ft the ^{40}K concentrations increase about 5 pCi/g and a thin fine-grained sediment layer exists where relatively higher moisture content is shown. The downward movement of the ^{60}Co is apparently retarded by this layer. Another thin sediment layer is shown at 75 ft by an increase in ^{40}K, ^{232}Th, and moisture. Between 130 and 135 ft increases in KUT and moisture are exhibited.

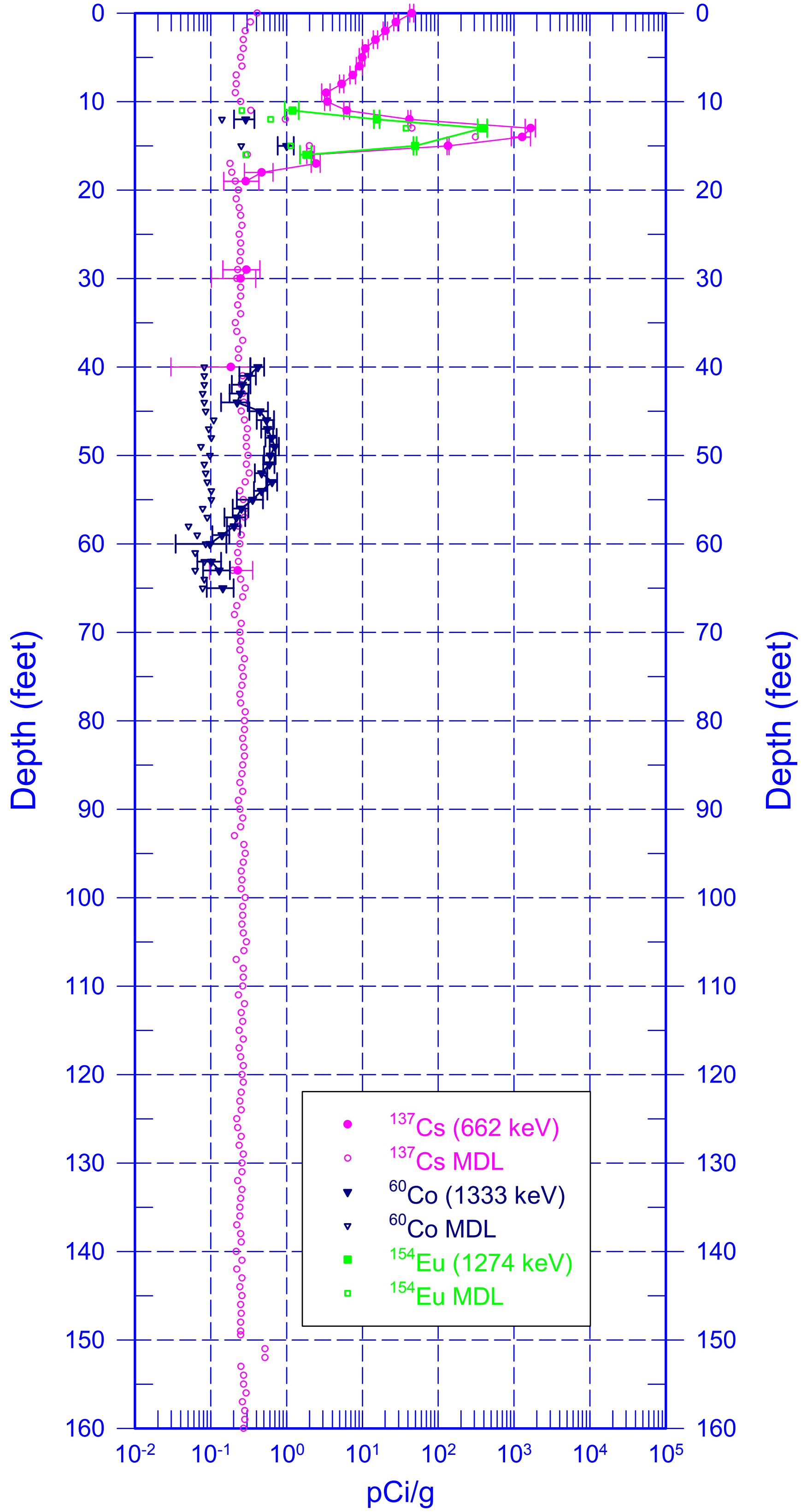
Log runs 3, 4, and 5 conducted March 3, 2004 show indications of enhanced radon as reflected by a slightly elevated naturally occurring ^{238}U concentration between the ground surface and 150 ft in depth. Where the casing size change occurs at approximately 150 ft, the moisture shows an increase in count rate. This increase in count rate is the result of a change from 10-in. to 8-in. casing and probably not a significant difference in moisture content.

The repeat sections indicated good agreement of the man-made radionuclides, naturally occurring KUT, and moisture.

---

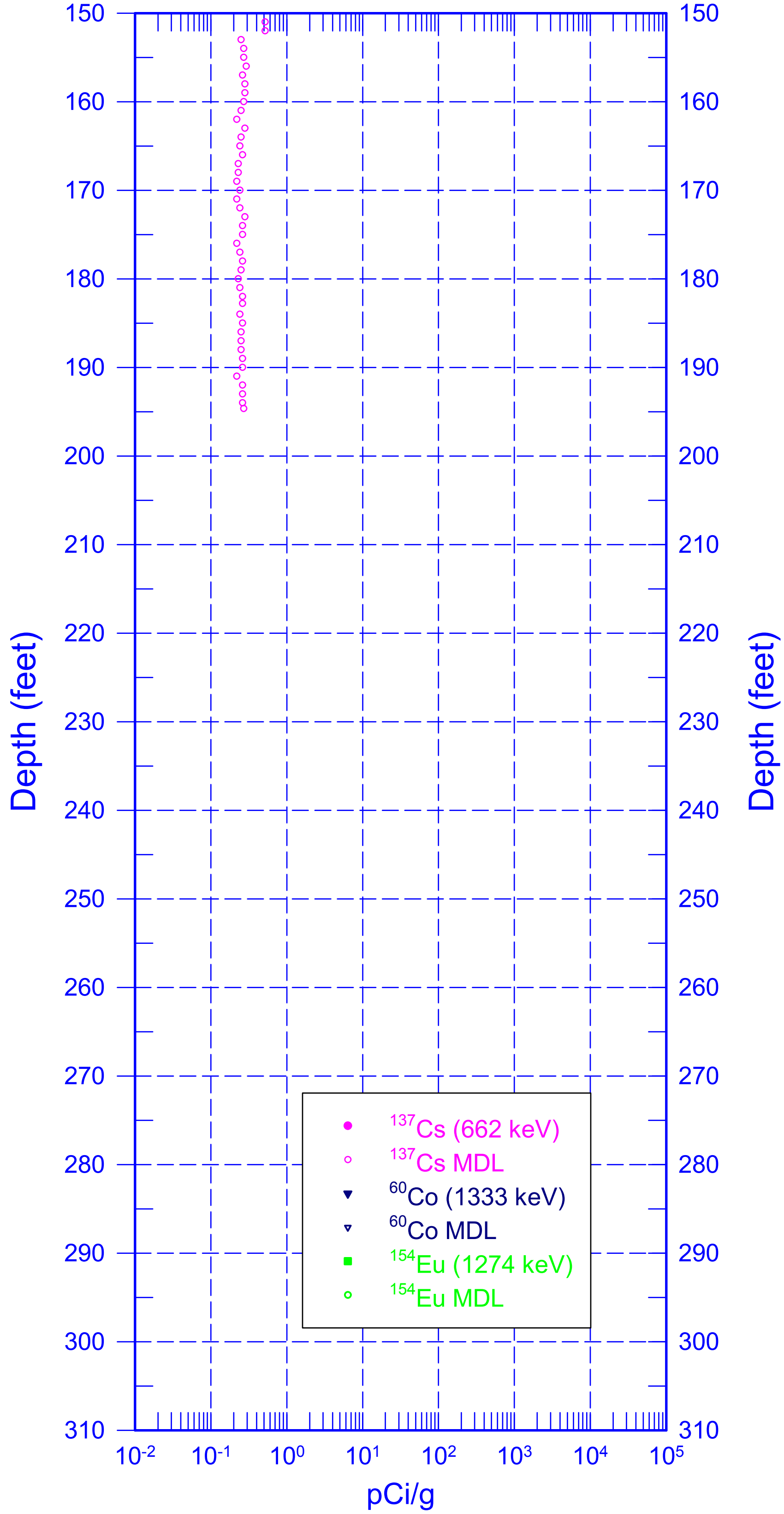
[1] GWL – groundwater level
[2] N/A – not applicable

C4297
Man-Made Radionuclides



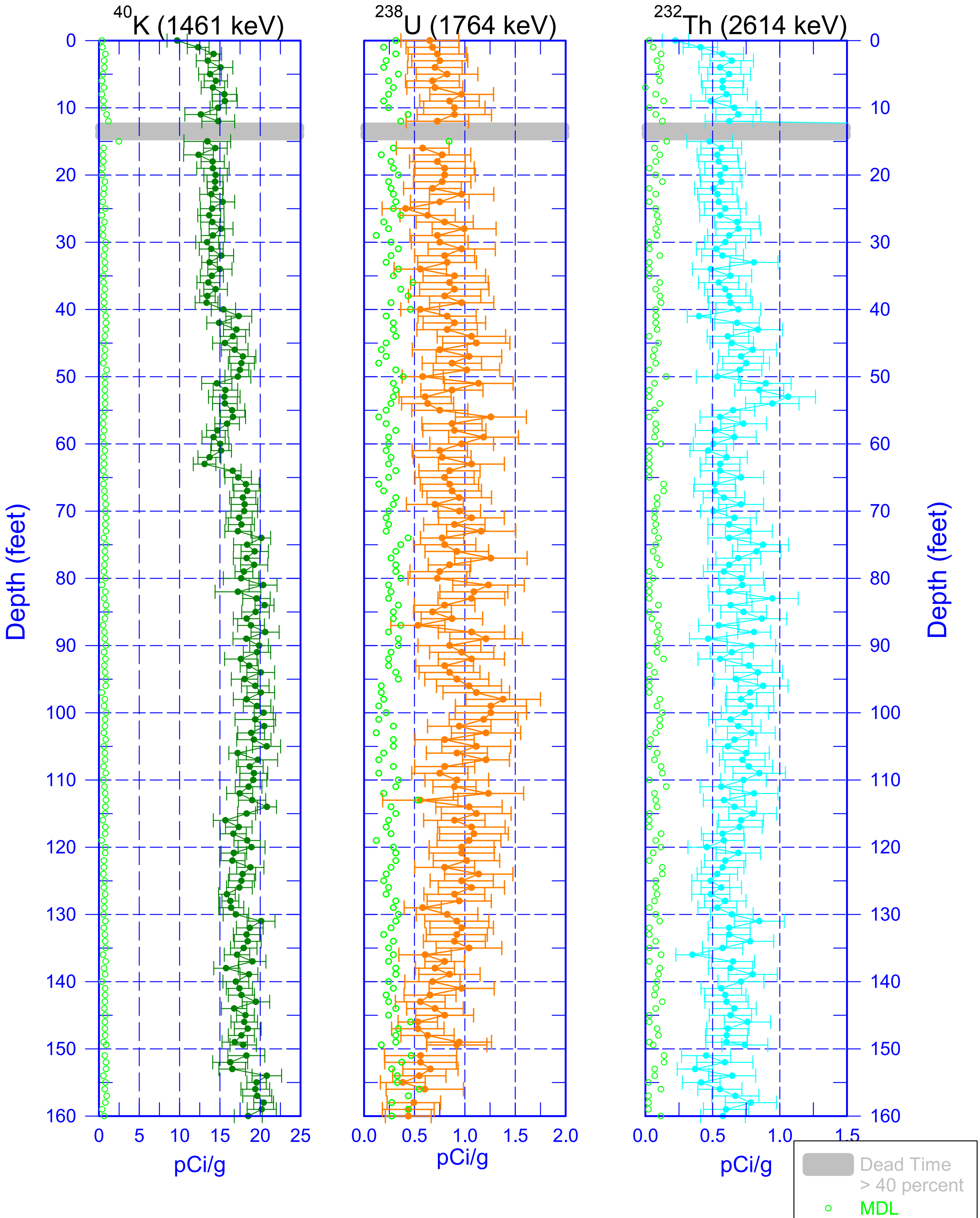
Zero Reference = Ground Surface   Depth scale: 1" = 20 ft   Last Log Date - 03/23/04

C4297
Man-Made Radionuclides



Zero Reference = Ground Surface Depth scale: 1" = 20 ft Last Log Date - 03/23/04

C4297
Natural Gamma Logs

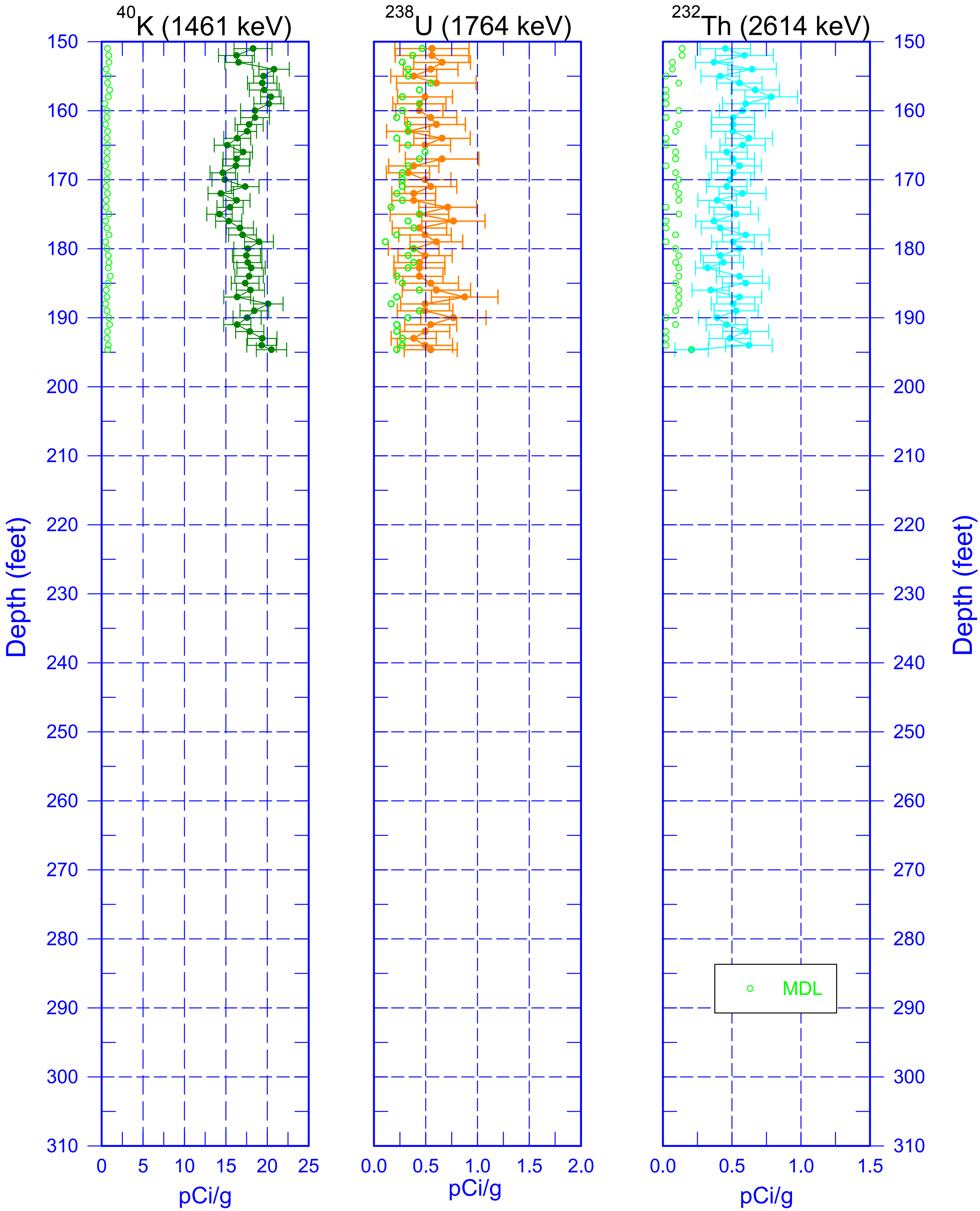


Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 03/23/04

C4297
Natural Gamma Logs

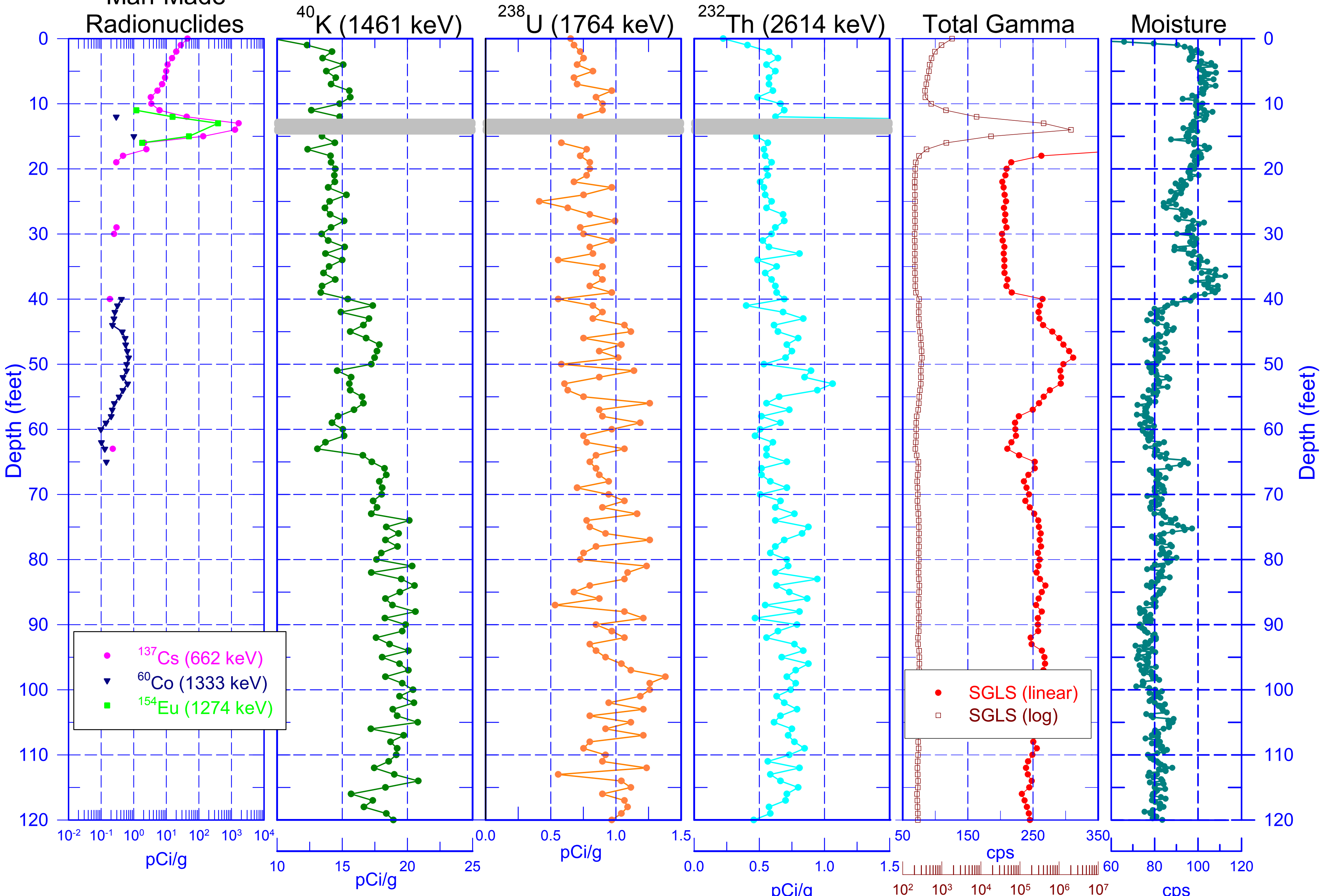


Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

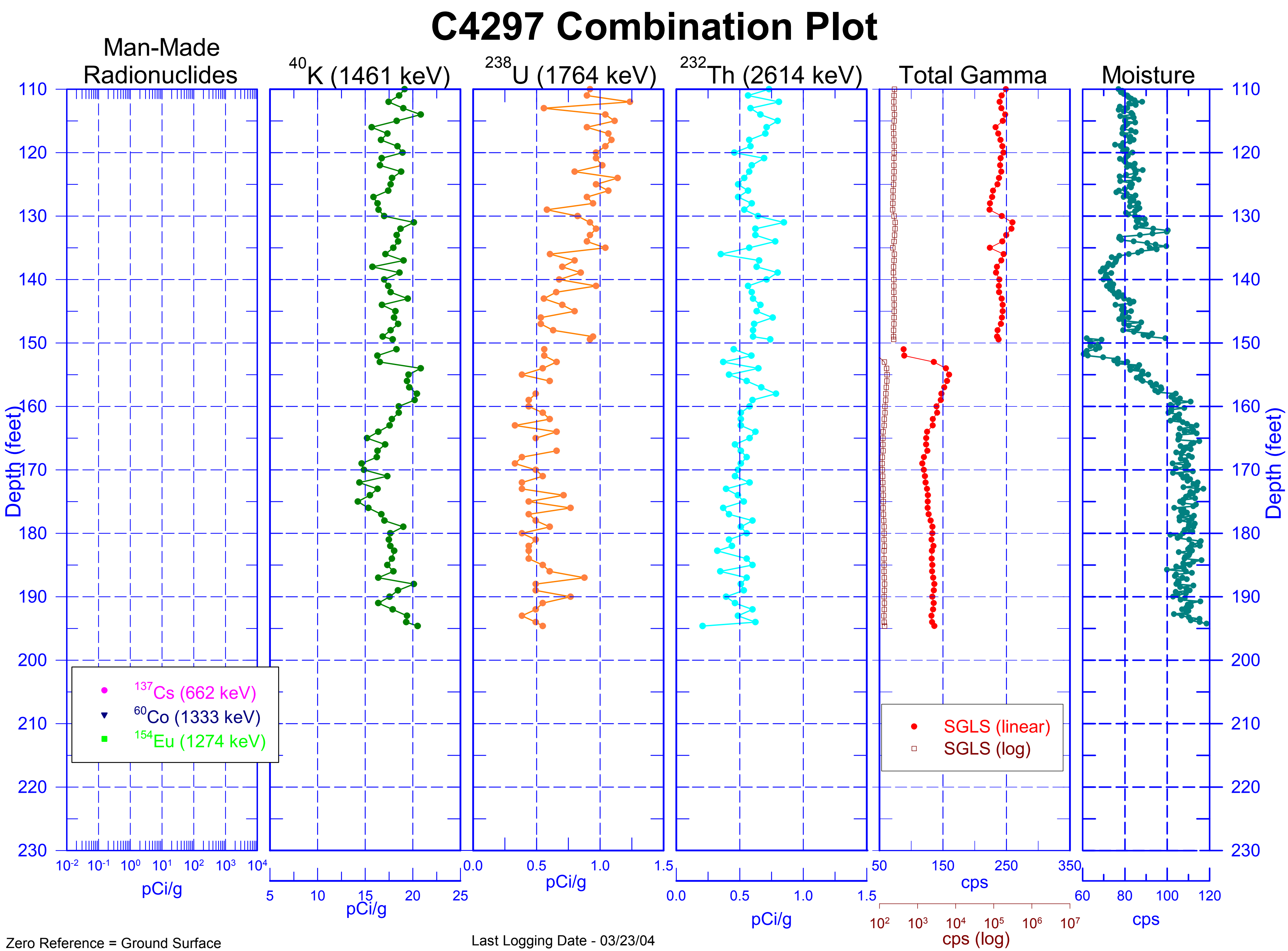
Last Log Date - 03/23/04

C4297 Combination Plot

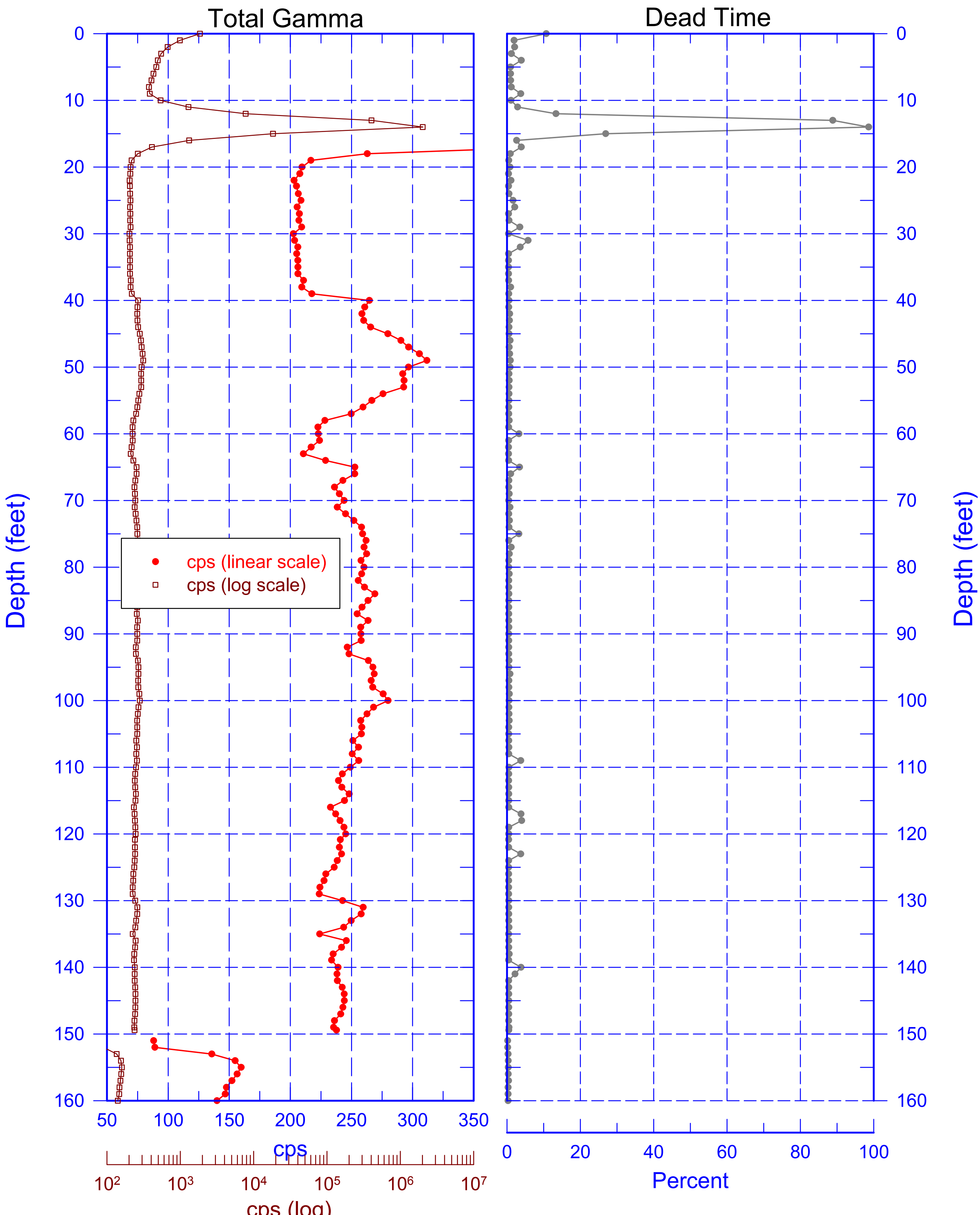


Zero Reference = Ground Surface

Last Logging Date - 03/23/04


C4297 Combination Plot
Man-Made Radionuclides
40K (1461 keV)
238U (1764 keV)
232Th (2614 keV)
Total Gamma
Moisture
Depth (feet)
137Cs (662 keV)
60Co (1333 keV)
154Eu (1274 keV)
SGLS (linear)
SGLS (log)
pCi/g
cps
cps (log)
Zero Reference = Ground Surface
Last Logging Date - 03/23/04

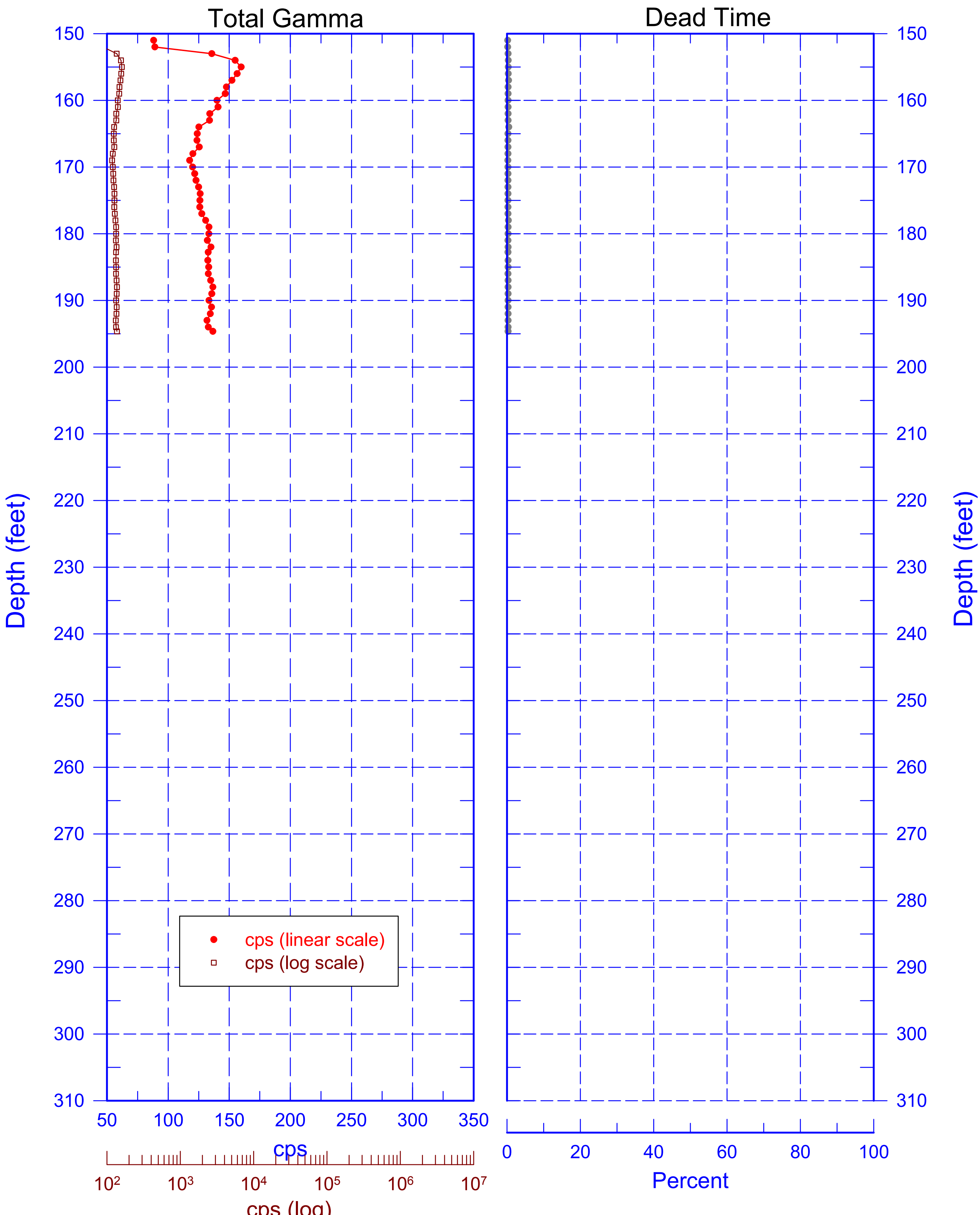
C4297
Total Gamma & Dead Time



Zero reference = Ground Surface

Last Log Date - 03/23/04

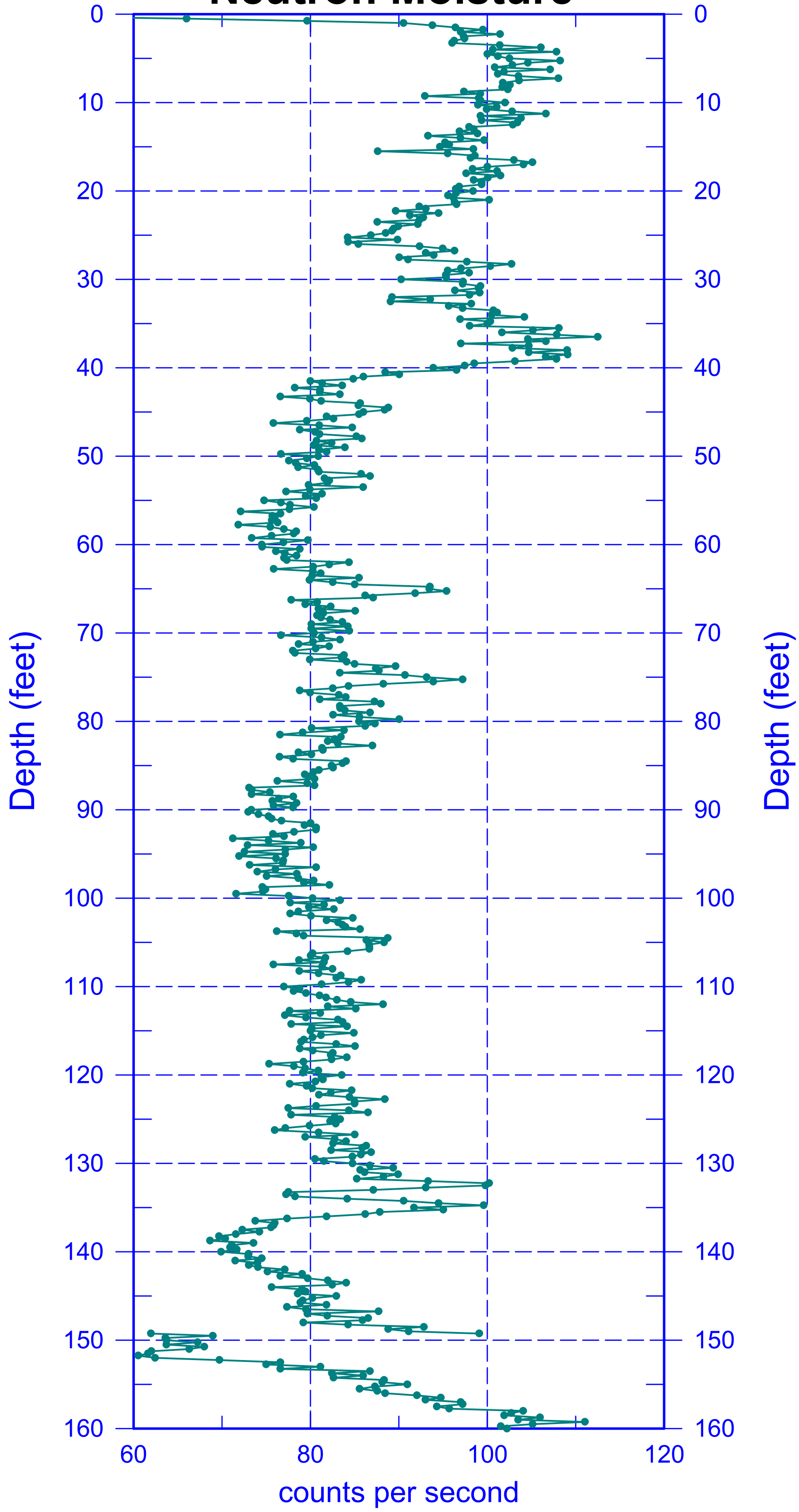
C4297
Total Gamma & Dead Time



Zero Reference = Ground Surface

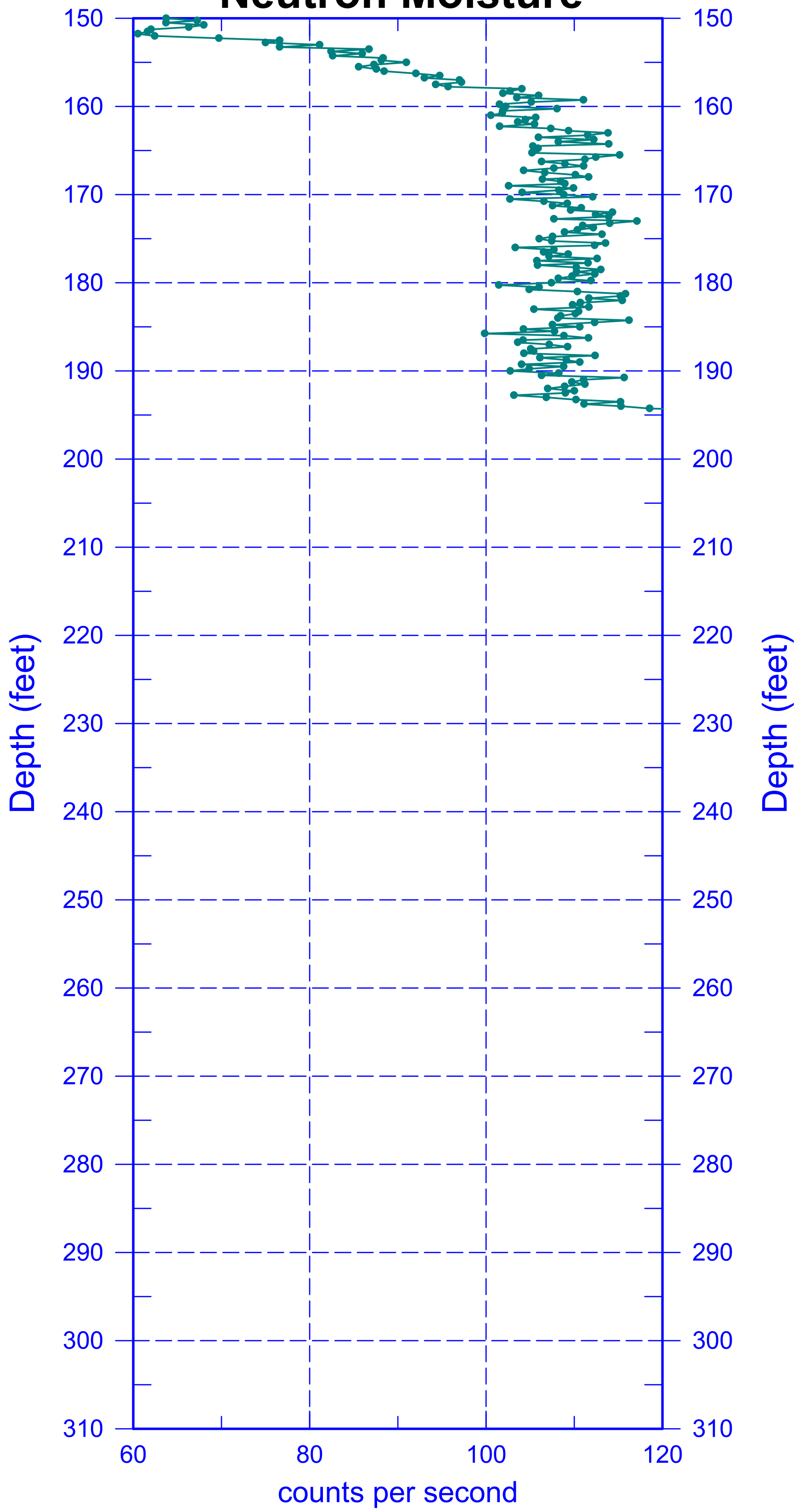
Last Log Date - 03/23/04

C4297
Neutron Moisture



Zero Reference = Ground Surface   Depth scale: 1" = 20 ft   Last Log Date - 03/23/04

C4297
Neutron Moisture



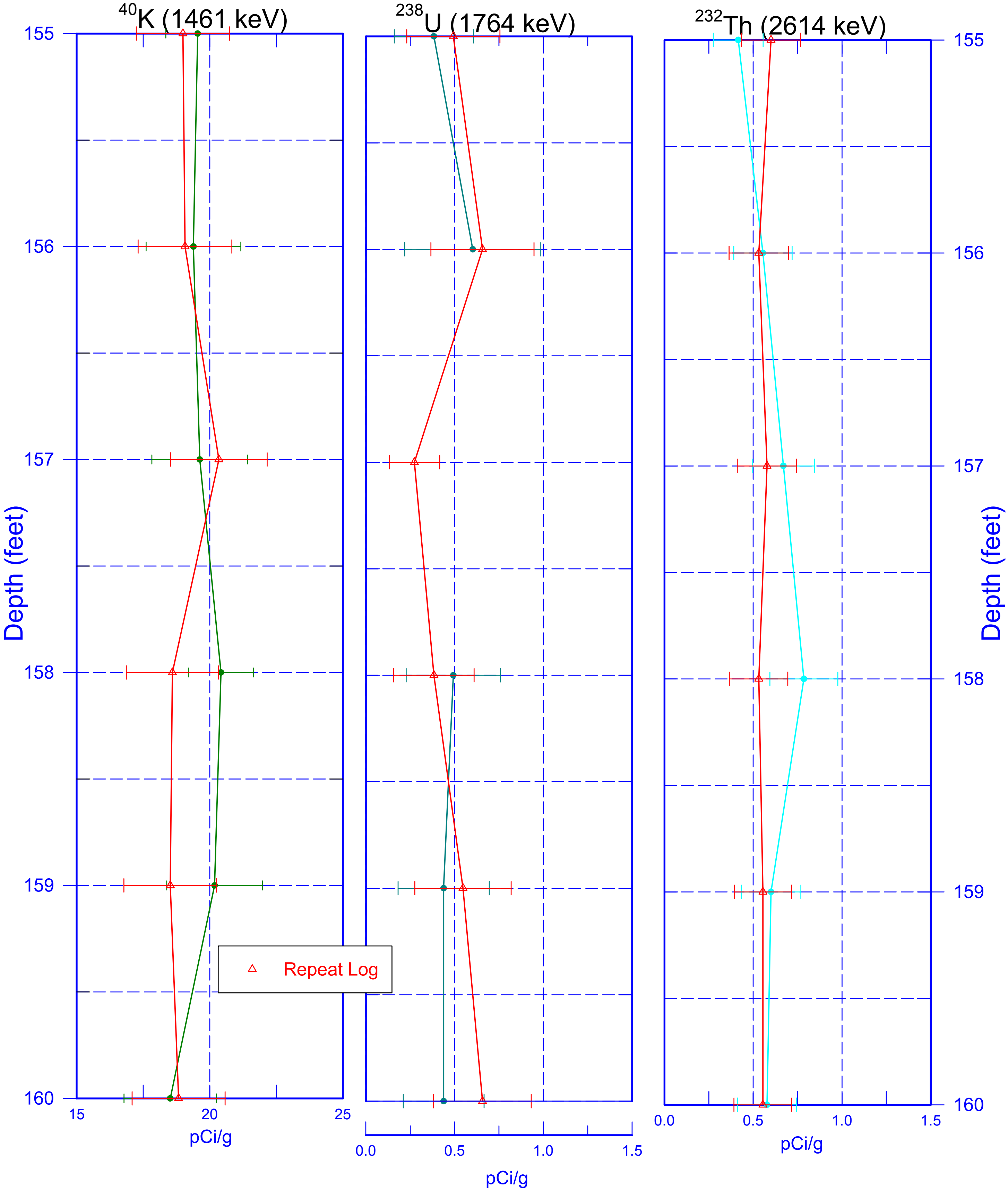
Zero Reference = Ground Surface

Depth scale: 1" = 20 ft

Last Log Date - 03/23/04

C4297

Repeat Section of Natural Gamma Logs

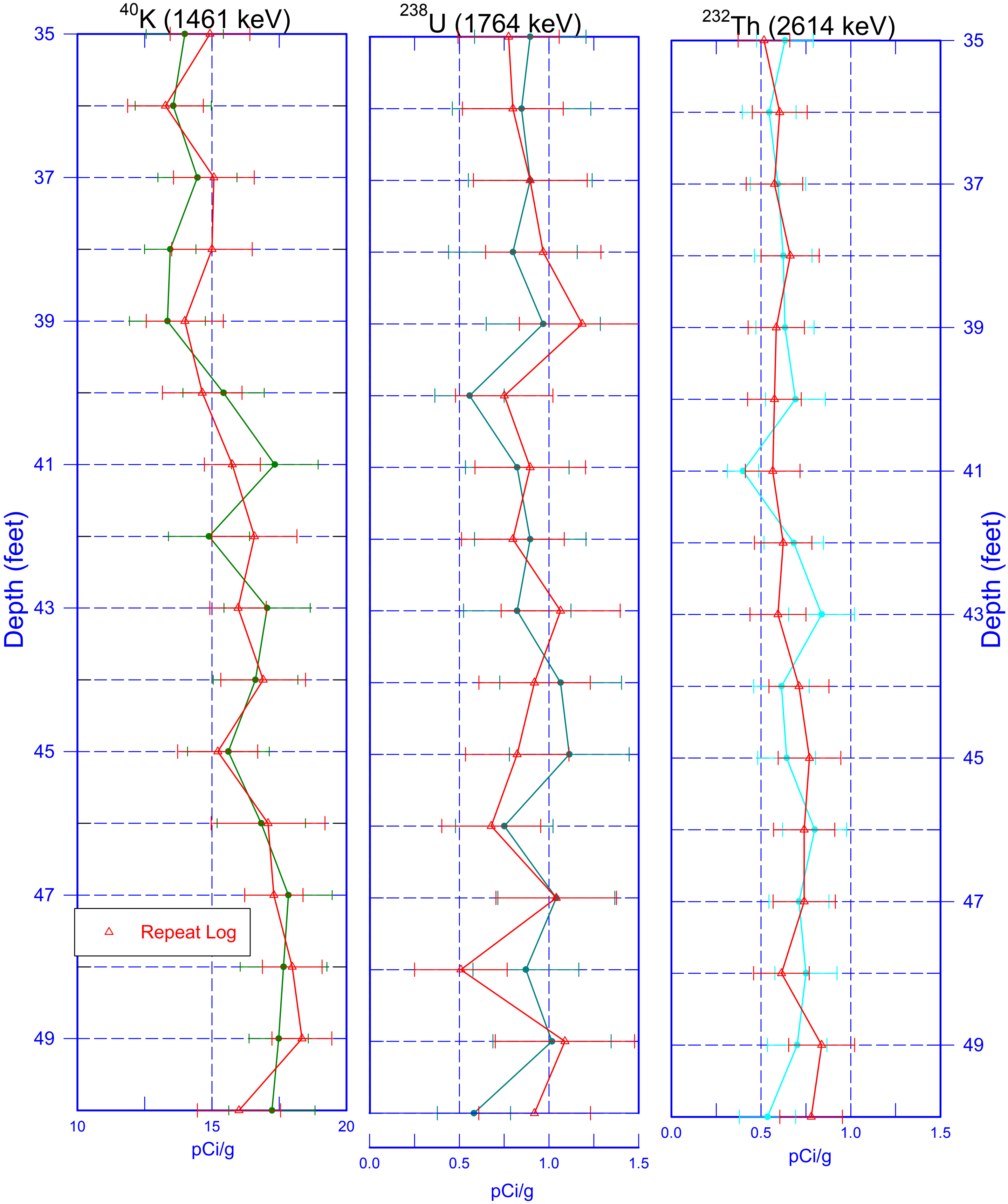


Zero Reference = Ground Surface

Last Log Date - 03/23/04

C4297

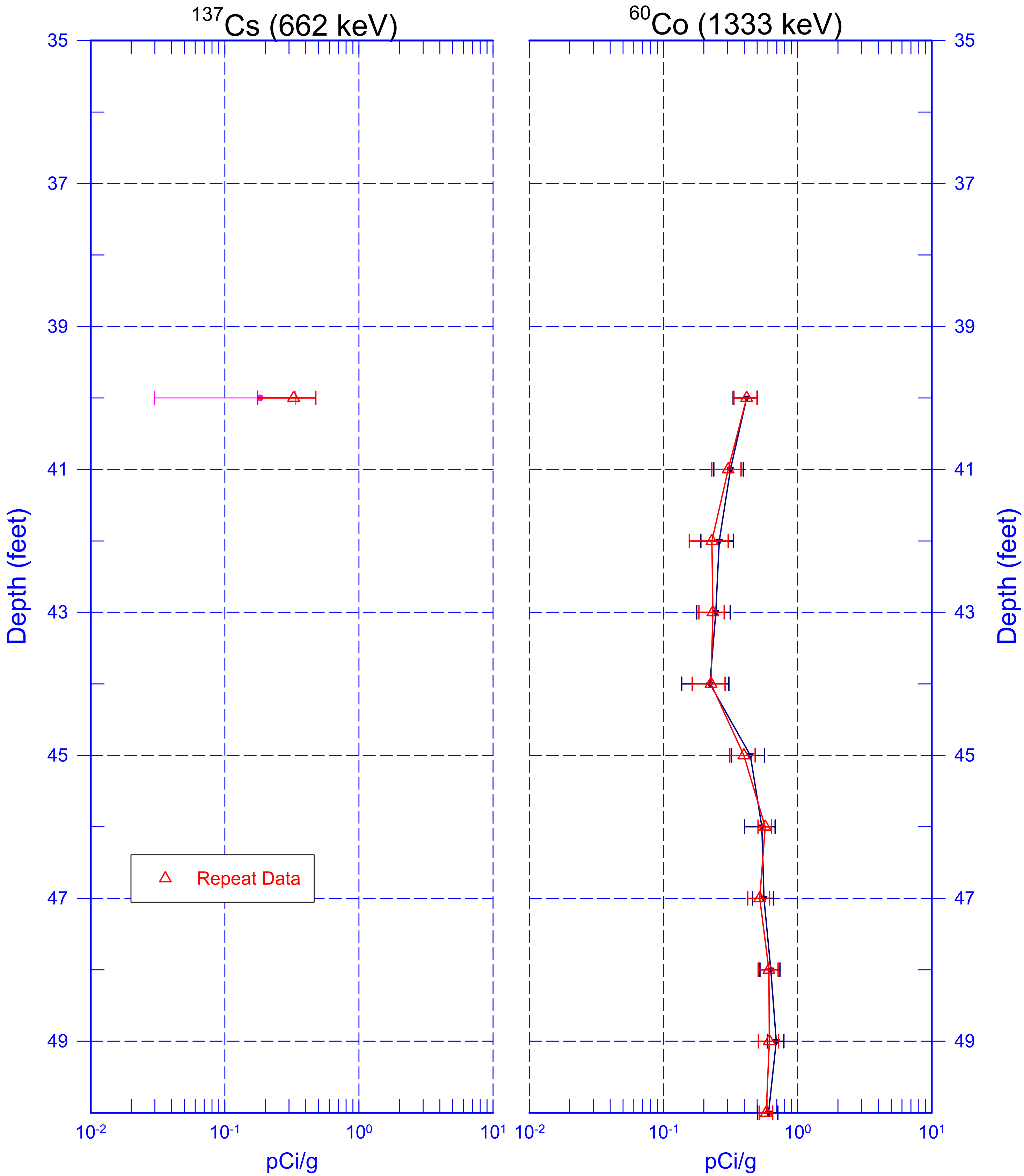
Repeat Section of Natural Gamma Logs



Zero Reference = Ground Surface

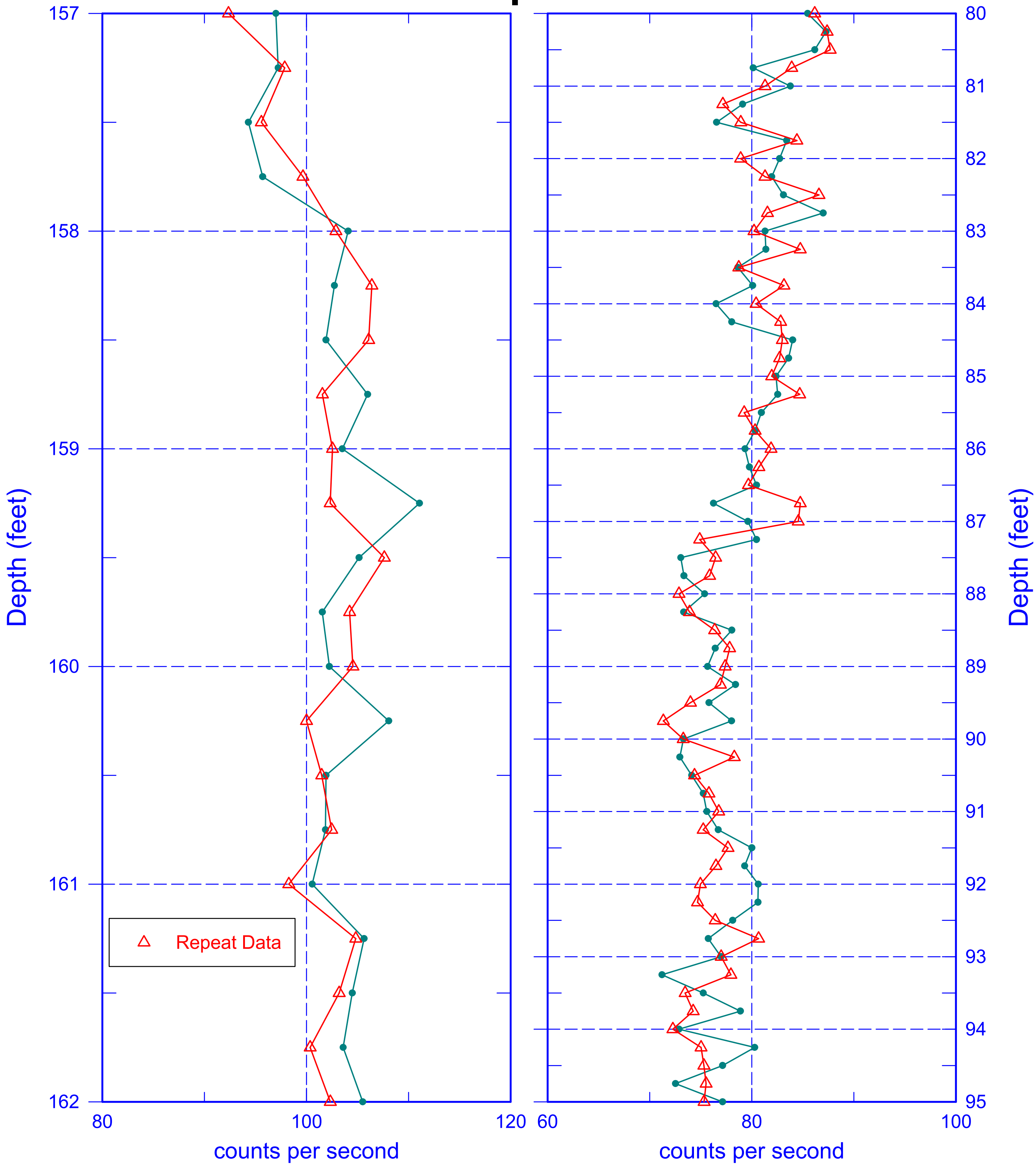
Last Log Date - 03/23/04

C4297
Repeat Section of Man-Made Radionuclides



Zero Reference = Ground Surface | Depth scale: 1" = 20 ft | Last Log Date - 03/23/04

C4297
Moisture Repeat Sections



Zero Reference = Ground Surface

Last Log Date - 03/23/04

Appendix D
Boreholes Projected for Monitoring
During the 3rd Quarter of FY 2004

Table D-1. Boreholes Projected for Routine Monitoring During the 3rd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Total Score	Frequency (days)	Next Event Date	Days Past Due	Last Event	Total Events (to date)	Comment
10-00-07	A-101	45	85	40	89	360	10/05/03	193	10/10/02	2	No apparent change
10-00-08	A-101	45	85	40	89	360	10/05/03	193	10/10/02	2	No apparent change
10-01-01	A-101	45	85	40	89	360	06/04/04	-50	06/10/03	3	No apparent change
10-01-03	A-101	45	78	33	89	360	06/04/04	-50	06/10/03	3	No apparent change
10-01-04	A-101	35	85	50	114	360	06/05/04	-51	06/11/03	3	No apparent change
10-01-05	A-101	45	85	40	89	360	10/04/03	194	10/09/02	2	No apparent change
10-01-06	A-101	45	85	40	89	360	10/02/03	196	10/07/02	2	No apparent change
10-01-08	A-101	45	85	40	89	360	10/02/03	196	10/07/02	2	No apparent change
10-01-09	A-101	45	63	18	89	360	10/02/03	196	10/07/02	2	No apparent change
10-01-10	A-101	45	85	40	89	360	10/02/03	196	10/07/02	2	No apparent change
10-01-11	A-101	45	85	40	89	360	10/02/03	196	10/07/02	2	No apparent change
10-01-16	A-101	20	52	32	114	360	06/06/04	-52	06/12/03	3	Decreasing counts
10-01-28	A-101	20	43	23	114	360	06/06/04	-52	06/12/03	3	Decreasing counts
10-01-39	A-101	20	44	24	114	360	06/06/04	-52	06/12/03	3	Decreasing counts
10-03-07	A-103	45	123	78	43	360	10/03/03	195	10/08/02	1	No apparent change
10-05-02	A-105	45	119	74	115	360	06/06/04	-52	06/12/03	3	No apparent change
10-05-05	A-105	45	74	29	115	360	06/04/04	-50	06/10/03	3	No apparent change
10-05-07	A-105	45	75	30	115	360	06/04/04	-50	06/10/03	3	No apparent change
10-05-08	A-105	45	55	10	115	360	06/04/04	-50	06/10/03	3	No apparent change
10-05-09	A-105	45	76	31	115	360	06/04/04	-50	06/10/03	3	No apparent change
10-05-10	A-105	25	100	75	140	360	06/03/04	-49	06/09/03	3	No apparent change
10-05-12	A-105	45	75	30	115	360	06/04/04	-50	06/10/03	3	No apparent change
20-00-05	B-101	35	110	75	37	360	04/08/04	7	04/14/03	2	No apparent change
20-01-01	B-101	35	75	40	37	360	04/08/04	7	04/14/03	2	No apparent change
20-01-06	B-101	25	59	34	37	360	04/02/04	13	04/08/03	2	No apparent change
20-07-02	B-107	35	100	70	38	360	04/15/04	0	04/21/03	2	No apparent change
20-07-11	B-107	35	90	55	38	360	04/15/04	0	04/21/03	2	No apparent change; possible Sr-90 at 72 ft
20-10-02	B-110	20	97	77	37	360	04/02/04	13	04/08/03	2	No apparent change; possible Sr-90 at 75 ft
20-10-07	B-110	35	75	40	37	360	04/02/04	13	04/08/03	2	No apparent change

Table D-1. Boreholes Projected for Routine Monitoring During the 3rd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Total Score	Frequency (days)	Next Event Date	Days Past Due	Last Event	Total Events (to date)	Comment
20-10-12	B-110	102	120	18	37	360	09/14/03	214	09/19/02	1	No apparent change
21-02-03	BX-102	35	98	63	106	180	03/21/04	25	09/23/03	5	No apparent change
21-02-04	BX-102	0	230	0	94	360	06/22/03	298	06/27/02	1	No apparent change; HRLS 6/27/02
21-03-03	BX-103	35	90	55	55	180	03/29/04	17	10/01/03	5	No apparent change
21-07-06	BX-107	20	102	0	36	360	05/15/03	336	05/20/02	1	No apparent change
21-27-01	BX-102	35	98	63	106	180	03/27/04	19	09/29/03	5	No apparent change
21-27-08	BX-102	35	148	113	106	180	03/22/04	24	09/24/03	5	Apparent change 137.5-148.5 ft not confirmed
21-27-11	BX-102	30	136	106	106	180	03/23/04	23	09/25/03	5	No apparent change
22-00-02	BY-103	40	98	58	63	180	05/03/04	-18	11/05/03	4	No apparent change
22-03-04	BY-103	40	100	60	63	180	05/04/04	-19	11/06/03	4	Possible change 77-82 ft not confirmed
22-03-05	BY-103	20	99	83	50	360	07/11/03	279	07/16/02	1	No apparent change
22-06-05	BY-106	20	97	77	76	180	10/04/03	194	04/07/03	3	No apparent change
22-06-07	BY-106	35	131	96	64	360	11/22/03	145	11/27/02	2	No apparent change
22-07-01	BY-107	40	98	58	43	360	11/15/03	152	11/20/02	2	No apparent change
22-07-02	BY-107	30	100	70	68	180	09/30/03	198	04/03/03	3	Apparent change 98-100 ft not confirmed
22-07-05	BY-107	30	97	67	68	180	09/30/03	198	04/03/03	3	Apparent change 75-81 ft not confirmed
22-07-07	BY-107	40	99	59	68	180	09/30/03	198	04/03/03	3	No apparent change
22-07-09	BY-107	20	99	84	55	360	11/28/03	139	12/03/02	2	No apparent change
22-08-01	BY-108	25	99	74	61	360	11/15/03	152	11/20/02	2	No apparent change
22-08-02	BY-108	25	102	77	74	180	10/01/03	197	04/04/03	3	No apparent change
22-08-05	BY-108	35	98	63	74	180	10/01/03	197	04/04/03	4	Apparent change 75-82 ft not confirmed
22-08-06	BY-108	40	98	58	61	360	11/14/03	153	11/19/02	2	No apparent change
22-08-07	BY-108	40	110	70	49	360	11/15/03	152	11/20/02	2	No apparent change
22-08-12	BY-108	30	100	70	74	180	10/01/03	197	04/04/03	3	No apparent change
22-10-05	BY-110	40	98	58	41	360	11/14/03	153	11/19/02	2	No apparent change
22-10-07	BY-110	40	90	50	53	180	09/30/03	198	04/03/03	3	No apparent change
30-01-06	C-101	30	70	40	43	360	04/30/04	-15	05/06/03	2	No apparent change
30-01-09	C-101	20	70	55	43	360	05/01/04	-16	05/07/03	2	No apparent change
40-04-07	S-104	35	80	45	52	360	06/13/04	-59	06/19/03	2	No apparent change

Table D-1. Boreholes Projected for Routine Monitoring During the 3rd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Total Score	Frequency (days)	Next Event Date	Days Past Due	Last Event	Total Events (to date)	Comment
40-07-01	S-107	35	80	45	38	360	06/12/04	-58	06/18/03	2	No apparent change
41-00-08	SX-109	40	90	50	58	180	01/07/04	99	07/11/03	5	No apparent change
41-02-02	SX-102	25	139	114	82	180	01/12/04	94	07/16/03	5	Possible change not confirmed; possible Sr-90
41-07-07	SX-107	40	74	25	56	180	02/08/04	67	08/12/03	4	No apparent change; HRLS 04/19/02
41-09-03	SX-109	40	74	31	46	180	02/04/04	71	08/08/03	2	No apparent change; HRLS 04/22/02
41-09-07	SX-109	40	73	35	58	180	02/03/04	72	08/07/03	4	No apparent change; HRLS 04/22/02
41-09-09	SX-109	40	95	66	58	180	02/04/04	71	08/08/03	4	No apparent change
41-10-01	SX-110	40	80	40	54	180	02/01/04	74	08/05/03	4	Possible ongoing Cs-137 increase at 66 ft
41-11-10	SX-111	40	95	69	54	180	02/02/04	73	08/06/03	4	No apparent change; HRLS 04/18/02
41-12-03	SX-112	40	75	40	63	360	02/08/04	67	02/13/03	2	No apparent change
41-14-06	SX-114	30	76	46	40	360	02/06/04	69	02/11/03	2	No apparent change
41-14-09	SX-114	40	75	35	40	360	02/06/04	69	02/11/03	2	No apparent change
41-14-11	SX-114	40	75	35	40	360	02/06/04	69	02/11/03	2	No apparent change
41-15-07	SX-115	40	90	50	65	360	02/07/04	68	02/12/03	2	Apparent Cs-137 increase (57-60ft)
50-00-09	T-106	30	120	90	142	180	11/17/03	150	05/21/03	4	No apparent change
50-00-10	T-106	30	70	40	92	360	08/24/03	235	08/29/02	2	No apparent change
50-01-06	T-101	30	87	57	48	360	08/23/03	236	08/28/02	2	No apparent change
50-01-09	T-101	30	90	60	61	180	11/11/03	156	05/15/03	5	Apparent change at 86-90 ft not confirmed
50-02-05	T-102	30	83	53	55	180	11/15/03	152	05/19/03	4	Apparent Cs-137 increase (39-41ft)
50-04-08	T-104	30	95	65	55	180	11/11/03	156	05/15/03	4	No apparent change
50-04-10	T-104	30	87	57	55	180	11/11/03	156	05/15/03	5	Apparent change 67-68 ft
50-05-11	T-105	30	120	90	39	360	08/23/03	236	08/28/02	2	No apparent change
50-06-02	T-106	30	122	92	142	180	12/14/03	123	06/17/03	5	Apparent change at 110 ft not confirmed
50-06-03	T-106	30	118	88	142	180	12/14/03	123	06/17/03	5	Apparent change at 115 ft not confirmed
50-06-04	T-106	55	93	68	117	360	07/24/03	266	07/29/02	1	No apparent change
50-06-05	T-106	30	116	86	130	360	07/21/03	269	07/26/02	1	No apparent change; requires HRLS
50-06-06	T-106	65	120	95	130	360	07/24/03	266	07/29/02	1	No apparent change
50-06-08	T-106	46	120	109	130	360	07/24/03	266	07/29/02	1	No apparent change
50-06-11	T-106	30	83	53	117	360	08/22/03	237	08/27/02	2	No apparent change

Table D-1. Boreholes Projected for Routine Monitoring During the 3rd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Total Score	Frequency (days)	Next Event Date	Days Past Due	Last Event	Total Events (to date)	Comment
50-06-16	T-106	30	86	61	130	360	08/29/03	230	09/03/02	2	No apparent change
50-06-17	T-106	30	87	57	117	360	07/25/03	265	07/30/02	1	No apparent change; requires HRLS
50-06-18	T-106	25	130	110	142	180	12/15/03	122	06/18/03	5	Poss. Incr. 117-119 ft (Co-60), poss. ongoing 6/18/03
50-09-01	T-109	30	86	56	54	180	12/13/03	124	06/16/03	5	Apparent change at 85 ft result of water level
50-09-02	T-109	30	86	56	54	180	12/13/03	124	06/16/03	3	Apparent change 81-86 ft caused by dif water levels
50-09-10	T-109	30	119	89	54	180	11/16/03	151	05/20/03	5	Apparent change at 76 and 94 ft not confirmed
51-01-02	TX-101	40	80	40	40	360	05/28/04	-43	06/03/03	2	No apparent change
51-03-09	TX-103	40	97	57	55	180	07/13/03	277	01/14/03	2	No apparent change
51-04-02	TX-104	40	90	50	41	360	05/24/04	-39	05/30/03	2	No apparent change
51-04-05	TX-104	40	97	57	53	180	07/13/03	277	01/14/03	2	No apparent change
51-04-06	TX-104	40	90	50	41	360	05/24/04	-39	05/30/03	2	No apparent change
51-05-01	TX-105	40	80	40	39	360	05/28/04	-43	06/03/03	2	No apparent change
51-05-03	TX-105	25	90	65	51	360	05/28/04	-43	06/03/03	2	No apparent change
51-05-05	TX-105	40	98	58	64	180	07/12/03	278	01/13/03	2	No apparent change
51-05-07	TX-105	40	106	66	63.9	180	07/13/03	277	01/14/03	2	No apparent change
51-16-04	TX-116	35	80	45	37.7	360	09/07/03	221	09/12/02	1	No apparent change
52-03-06	TY-103	40	100	60	55.85	180	11/18/03	149	05/22/03	5	Definite change 55-60 ft; report issued 5/14/02
52-05-07	TY-105	40	96	56	81.6	180	11/24/03	143	05/28/03	3	No apparent change
52-06-04	TY-106	40	97	57	53.8	360	05/22/04	-37	05/28/03	2	No apparent change
52-06-05	TY-106	40	147	107	66.3	180	11/23/03	144	05/27/03	3	Possible change 130-148 ft, ongoing 12/04/03, 5/27/03
52-06-06	TY-106	40	99	59	53.8	360	05/22/04	-37	05/28/03	2	No apparent change
52-06-07	TY-106	200	238	38	41.3	360	05/16/04	-31	05/22/03	2	No app. change; Co may be in GW, Radon on 5/22/03
60-04-08	U-104	40	118	78	94	180	02/10/04	65	08/14/03	8	Apparent change (74-78 and 84-89 ft) not confirmed
60-05-04	U-105	35	72	37	44.1	180	02/09/04	66	08/13/03	6	No apparent change
60-05-05	U-105	35	123	88	44.1	180	02/11/04	64	08/15/03	5	Possible increase 75-80 ft
60-07-01	U-107	0	98	98	50	180	02/09/04	66	08/13/03	8	Apparent change 83-88 ft not confirmed

Table D-2. Boreholes Projected for Retrieval Monitoring During the 3rd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Next Log Date	Last Event Date	Projected 3rd Qtr. Events	Total Events (to date)	Comment
30-00-01	C-106	0	65	65	03/31/04	03/01/04	1	8	No apparent change, C-106 Retrieval
30-03-01	C-103	0	124	124	05/17/97	04/17/97	2	0	Cannot log because of stairwell; C-103 Retrieval
30-03-03	C-103	0	97	97	05/11/97	04/11/97	2	0	Water in borehole 10/01, C-103 Retrieval
30-03-05	C-103	0	99	99	10/11/02	09/11/02	2	1	No apparent change, C-103 Retrieval
30-03-07	C-103	0	96	96	10/11/02	09/11/02	2	1	No apparent change, C-103 Retrieval
30-03-09	C-103	0	98	98	06/05/03	05/06/03	2	2	No apparent change, C-103 Retrieval
30-04-02	C-104	0	134	134	02/27/03	01/28/03	2	1	No apparent change, C-105 Retrieval
30-05-02	C-105	5	127	122	03/20/04	02/19/04	2	8	No apparent change, C-106 Retrieval
30-05-03	C-105	0	98	98	05/31/03	05/01/03	2	2	No apparent change, C-105 Retrieval
30-05-04	C-105	0	117	117	05/31/03	05/01/03	2	2	No apparent change, C-105 Retrieval
30-05-05	C-105	0	98	98	05/31/03	05/01/03	2	2	No apparent change, C-105 Retrieval
30-05-06	C-105	0	57	57	02/27/04	01/28/04	2	1	No apparent change, C-105 Retrieval
30-05-07	C-105	30	48	18	06/06/03	05/07/03	2	2	No apparent change; requires HRLS, C-105 Retrieval
30-05-08	C-105	0	48	48	05/31/03	05/01/03	2	2	No apparent change, C-105 Retrieval
30-05-09	C-105	0	100	100	02/25/04	01/26/04	2	1	No apparent change, C-105 Retrieval
30-05-10	C-105	0	135	135	08/22/03	07/23/03	2	2	No apparent change, C-105 Retrieval
30-06-02	C-106	0	122	122	03/24/04	02/23/04	1	7	No apparent change, C-106 Retrieval
30-06-03	C-106	0	98	98	03/24/04	02/23/04	1	7	No apparent change, C-106 Retrieval
30-06-04	C-106	0	129	129	03/26/04	02/25/04	2	8	No apparent change, C-106 Retrieval
30-06-09	C-106	5	98	93	03/20/04	02/19/04	1	8	No apparent change, C-106 Retrieval
30-06-10	C-106	0	128	128	03/27/04	02/26/04	1	8	Possible change 124-126 ft Co-60, C-106 Retrieval
30-06-12	C-106	0	98	98	03/31/04	03/01/04	1	8	No apparent change, C-106 Retrieval
30-08-02	C-108	30	99	69	03/18/04	02/17/04	1	8	Def change in Co-60 49-75 ft, down move, C-106 Retrieval
30-09-06	C-109	30	98	68	03/21/04	02/20/04	1	7	No apparent change, C-106 Retrieval
30-09-07	C-109	30	121	91	03/18/04	02/17/04	1	7	No apparent change, C-106 Retrieval
40-02-01	S-102	0	129	129	08/01/03	07/02/03	3	2	No apparent change, S-102 Retrieval
40-02-03	S-102	0	98	98	08/07/03	07/08/03	3	1	Apparent Cs-137 increase at 44-47 ft., S-102 Retrieval
40-02-04	S-102	0	144	144	08/08/03	07/09/03	3	2	No apparent change, S-102 Retrieval
40-02-05	S-102	0	97	97	08/06/03	07/07/03	3	2	No apparent change, S-102 Retrieval
40-02-07	S-102	0	95	95	08/06/03	07/07/03	3	2	No apparent change, S-102 Retrieval
40-02-08	S-102	0	99	99	08/06/03	07/07/03	3	2	No apparent change, S-102 Retrieval
40-02-10	S-102	0	100	100	07/31/03	07/01/03	3	2	No apparent change, S-102 Retrieval
40-02-11	S-102	0	100	100	08/01/03	07/02/03	3	2	No apparent change, S-102 Retrieval
40-03-03	S-103	0	122	122	10/16/02	09/16/02	3	1	No apparent change, S-102 Retrieval
40-09-06	S-109	0	98	98	03/06/04	02/05/04	3	6	No apparent change; S-112 Retrieval
40-11-08	S-111	0	97	97	03/05/04	02/04/04	3	4	No apparent change, S-112 Retrieval
40-11-09	S-111	0	98	98	03/06/04	02/05/04	3	5	No apparent change, S-112 Retrieval
40-12-02	S-112	0	99	99	03/06/04	02/05/04	3	6	No apparent change; S-112 Retrieval
40-12-04	S-112	0	126	126	03/05/04	02/04/04	3	6	No apparent change; S-112 Retrieval
40-12-06	S-112	0	144	144	03/10/04	02/09/04	3	6	No apparent change; S-112 Retrieval
40-12-07	S-112	0	98	98	03/07/04	02/06/04	3	6	No apparent change; S-112 Retrieval
40-12-09	S-112	0	98	98	03/07/04	02/06/04	3	6	No apparent change; S-112 Retrieval
		Total Projected 3rd Quarter Events =					**92**		

Table D-3. Boreholes Projected for Retrieval Moisture Logging During the 3rd Quarter of FY 2004

Borehole Number	Tank	Top	Bottom	Footage	Next Event Date	Last Event Date	Projected 3rd Qtr. Events	Total Events (to date)	Comment
30-03-01	C-103	0	124	124	TBD	NA	2	0	No moisture logging performed to date.
30-03-03	C-103	0	97	97	TBD	NA	2	0	No moisture logging performed to date.
30-03-05	C-103	0	99	99	TBD	NA	2	0	No moisture logging performed to date.
30-03-07	C-103	0	96	96	TBD	NA	2	0	No moisture logging performed to date.
30-03-09	C-103	0	98	98	TBD	NA	2	0	No moisture logging performed to date.
30-04-02	C-104	0	134	134	TBD	09/17/03	2	1	Only one event, no comparison
30-05-02	C-105	0	127	127	03/12/04	02/11/04	2	6	Possible increase 42-70 ft
30-05-03	C-105	0	98	98	TBD	NA	2	0	No moisture logging performed to date.
30-05-04	C-105	0	117	117	TBD	NA	2	0	No moisture logging performed to date.
30-05-05	C-105	0	98	98	TBD	09/16/03	2	1	Only one event, no comparison
30-05-06	C-105	0	57	57	TBD	NA	2	0	No moisture logging performed to date.
30-05-07	C-105	0	48	48	TBD	NA	2	0	No moisture logging performed to date.
30-05-08	C-105	0	48	48	TBD	NA	2	0	No moisture logging performed to date.
30-05-09	C-105	0	100	100	TBD	NA	2	0	No moisture logging performed to date.
30-05-10	C-105	0	136	136	TBD	09/17/03	2	1	Only one event, no comparison
30-06-02	C-106	0	122	122	03/19/04	02/18/04	1	6	Possible increase 56-76 ft
30-06-03	C-106	0	98	98	03/18/04	02/17/04	1	6	Possible increase 57-68 ft
30-06-04	C-106	0	129	129	03/31/04	03/01/04	2	6	Possible increase 45-53 ft
30-06-09	C-106	0	98	98	03/13/04	02/12/04	1	6	Possible increase 50-72 ft
30-06-10	C-106	0	128	128	03/18/04	02/17/04	1	6	Possible increase 42-58 ft
30-06-12	C-106	0	98	98	03/19/04	02/18/04	1	6	Possible increase 50-60 ft
30-08-02	C-108	0	99	99	03/21/04	02/20/04	1	2	No apparent increase
30-09-06	C-109	0	98	98	03/13/04	02/12/04	1	2	No apparent increase
30-09-07	C-109	0	121	121	03/13/04	02/12/04	1	2	No apparent increase
40-02-01	S-102	0	129	129	TBD	NA	3	0	No moisture logging performed to date.
40-02-03	S-102	0	98	98	TBD	NA	3	0	No moisture logging performed to date.
40-02-05	S-102	0	97	97	04/24/04	03/25/04	3	1	No moisture logging performed to date.
40-02-07	S-102	0	95	95	04/30/04	03/31/04	3	1	No moisture logging performed to date.
40-02-08	S-102	0	99	99	TBD	NA	3	0	No moisture logging performed to date.
40-02-10	S-102	0	100	100	TBD	NA	3	0	No moisture logging performed to date.
40-02-11	S-102	0	100	100	04/24/04	03/25/04	3	1	No moisture logging performed to date.
40-03-03	S-103	0	122	122	TBD	NA	3	0	No moisture logging performed to date.
40-09-06	S-109	0	98	98	03/10/04	02/09/04	3	4	Possible increase 40-50 ft
40-11-08	S-111	0	96	96	03/10/04	02/09/04	3	3	None
40-11-09	S-111	0	98	98	03/07/04	02/06/04	3	3	Possible increase 23-33 ft
40-12-02	S-112	0	99	99	03/07/04	02/06/04	3	4	Possible increase 32-47 ft
40-12-04	S-112	0	126	126	03/10/04	02/09/04	3	4	Possible increase 53-55 ft
40-12-06	S-112	0	144	144	03/11/04	02/10/04	3	4	Possible increase 35-49 ft
40-12-07	S-112	0	96	96	03/11/04	02/10/04	3	4	Possible increase 23-43 ft
40-12-09	S-112	0	99	99	03/10/04	02/09/04	3	4	Possible increase 37-50 ft
			Total Projected 3rd Quarter Events =				**88**		